ELECTRICAL REVIEW

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VIEWS, NEWS AND INTERVIEWS.

There is more capital invested in electric railways in Ohio than in any other State of the Union. Louisiana, South Dakota and Rhode Island are together at the foot of the list.

It costs $2.82 per word to send a cablegram from New York city to New Zealand.

Surprise is felt that Cyrus W. Field left so small a sum to his family. But did he not leave to the world at large benefits which no amount of mere wealth could have purchased?—*New York Recorder*.

"We make our membership in the National Electric Light Association pay us," said the manager of a large central station in New York city. "Every paper of a practical nature read before the Association is dissected in our station and all the kinks, short cuts and experiments are tried under the conditions existing in our work. We have made several valuable discoveries in central station practice in this way, and regard our membership in the Association as indispensable."

Lieutenant Totten has emerged from a restful and protracted period of obscurity to startle us with the theory that they have electric cars in heaven. Inasmuch as Totten is not a fire-eater, we say without any trace of fear or hesitation that he is an ass.—*N. Y. Commercial Advertiser*.

The ladies of Worthington, Mo., and vicinity have pledged themselves to raise a balance of $1,500 for the Columbus and Worthington electric road.

The Edison Electric Light and Power Company is erecting a structure in San Francisco, one great feature of which will be its tall chimney. This chimney will be 175 feet above the pavement. It will be built on foundations of solid concrete 10 feet thick and 28 feet square below the street level. The estimated cost is placed at $10,000.

The telephone girl is destined to fill a page in history. Her failings and her virtues have been celebrated in song and story. The Washington *Star* recently broke forth thusly:

"Give me the Treasury, please," he cried,
To a maid with dark brown curl.
"I'll do it with pleasure, sir," she replied,
For she was a telephone girl.

To which the New York *Evening Sun* replied:

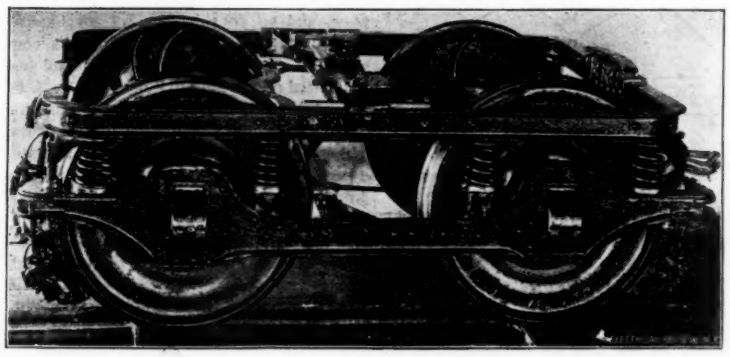
Of course the Treasury was naught to her
If she wore a "dark brown curl,"
But if she said "with pleasure, sir,"
She was not a telephone girl.

Three prisoners, handcuffed together, were placed on a train at Petaluma, Cal., without a guard, to be transported to Santa Rosa. A telephone message to the latter place instructed an officer to meet the 7.20 train carrying the convicts. This was done and the three men were safely lodged in the county jail.

The height of politeness for a government clerk—to take off his hat when speaking to his superior officer through the telephone.

During the Knights Templar parade at Denver, the electrical illumination of the line of march was a beautiful feature. There were 21,000 lights altogether, 8,500 being red, 6,000 white, 4,200 blue, 1,800 green and 800 old gold.

A New York pharmacist has a novel fly trap in his store window. It is run by a little electric motor and gathers in the flies with great celerity and absolute certainty. A piece of strong brown paper, about four inches wide and 15 inches long, is fastened in a continuous band around two rollers, which are kept revolving at a slow rate by the motor. The band is slightly smeared with a sweet substance. Two-thirds of the length of the band is freely exposed, but at the other roller it runs under a wire cone and then against a brush. The flies alight on the slowly moving band and unsuspectingly remain there sipping the sweets until brushed off, when they fly up into the cone, from which they can find no exit. The cone is a species of fly trap, quite a common device, but the electric motor does not leave it to the flies to get into the trap, but railroads them to destruction. The way it catches flies is a caution.



McGUIRE TRUCK FOR THE ELECTRIC ELEVATED ROAD AT KANSAS CITY.

The McGuire Truck for the Electric Elevated Road at Kansas City.

The accompanying cut illustrates the type of truck built by the McGuire Manufacturing Company, Chicago, for the Inter-State Consolidated Railway Company, Kansas City, Mo., for use on their elevated railroad, power for which is being changed from steam to electricity. This is the largest and heaviest motor truck ever built and run on an electric railroad.

The truck complete weighs 6,000 pounds, with dimensions as follows: Six foot six inch wheel base, four foot eight and one-half inch gauge, and fitted with 36 inch plate wheels, weighing 600 pounds each.

This is a maximum traction truck, giving 80 per cent. of the traction on the wheels. Forty of these trucks will be placed on the road mentioned above, each equipped with Westinghouse 30 horse-power S. R. G. motors, and each pair of trucks will carry a 35 foot car body. The McGuire Manufacturing Company placed 70 of this type of truck, but of a lighter weight, on the San Francisco and San Mateo road in San Francisco, and letters recently received from this road speak in the highest terms of the trucks, which are giving the very best satisfaction.

ELECTRICAL PEOPLE WE MEET.

Mr. James I. Ayer, of St. Louis, is a man on whom the eyes of the whole electrical fraternity will rest next February. He will be right where everybody can see him, too. As president of the National Electric Light Association, Mr. Ayer will look after the interests of the hundreds of delegates to the next convention, which assembles in his city in February. Mr. Ayer is the general manager of the largest arc light plant in the world, that of the Municipal Electric Light and Power Company, of St. Louis, and has the unique distinction of having sold the apparatus, built the station and afterwards managing it. He has many friends, and is a representative, able and progressive central station man.

Mr. E. A. Leslie, the general manager of the Manhattan Electric Light Company, of New York, is an old-time telegraph operator. In his younger days he and a lot of other operators had a house in Waverly Place, which became famous as the rendezvous of the most distinctly Bohemian set in the city. Some wonderful stories are told of this house. Mr. Leslie became chief operator of the Western Union office in this city, and was afterwards vice-president and superintendent of the Baltimore and Ohio Telegraph Company. His present position is one of great responsibility, as his company's lines cover a large and sometimes troublesome territory. Mr. Leslie is one of the best informed central station managers in the country, and his information is of that practical character which is so valuable. He is passionately fond of music and is regarded as a critic in musical matters. Mr. Leslie is a member of the National Electric Light Association, the New York Electric Club and other organizations.

Prof. Elisha Gray, of Highland Park, Ill., the well-known electrician and inventor of the telautograph, arrived in New York from Europe last week. When seen at the Windsor Hotel, he said: "My trip to Europe was in every respect delightful and a success in the mission that took me over. My main business was to take a needed rest, but I improved the chance to do something for the electrical department of the World's Fair. As the official head of that department, it seemed proper to me to arrange for a congress of electrical scientists to be held next year at the fair, and it was this that took me to the capitals of Europe. I visited England, France, Germany, Austria, Italy, Greece and Turkey, and was everywhere received with consideration. I now regard the congress as practically organized. It will be composed of between 2,000 and 3,000 delegates, and every delegate will be a man identified in some way with the electrical art. It will be by far the greatest gathering of scientists the world ever saw."

LIGHT AND POWER STATIONS.

SOME HINTS TO OWNERS AND OPERATORS BY A PRACTICAL ENGINEER.

Bad Results from Poor Selections of Station Sites—Some Illustrations With a Moral—Value of Permanent Work—An Ideal Station Site.

BY ROBB MACKIE.

V.

It seems needless to further dwell upon the subject of location of stations, and yet it should not be passed by without some illustrations of poor selections of sites for plants that have come under my notice.

One case will illustrate that, even among those interested in the success of the enterprise, some in "grinding their own axes" do so at the cost of the best profits on the plant.

In a company organized for the purpose of building and operating an electric plant, when it came to the selection of the site one stockholder offered a piece of property for $1,500, and another stockholder a piece for $4,500. After much contention, the owner of the latter carried the day, on the argument (about which they all were in ignorance of the facts) that the $1,500 property was 600 feet further away from the district to be lighted, and therefore the additional cost of the conductor wires for this increased distance would more than eat up the difference, "to say nothing of the additional constant loss on the lines." What is the result? In the first place, the additional cost of the wire necessary, for double the load calculated for originally, which would have been necessary to carry the current the additional 600 feet, has been calculated as only $2,000, while, when the two plants are examined from an engineer's standpoint, it is found that had the cheaper site been taken a switch could have been laid in from a railroad near at hand, permitting the dumping of the fuel directly in front of the boilers, thus saving the present cost of haulage and handling, which now adds about $250 to the cost of fuel. At an additional small expense a supply pipe could have been laid to an available water supply, which would have supplied the boilers throughout the year and given them water for condensing engines for full time during nine months of the year, and for the hours of full load during the remaining three months. The water supply cannot be laid the additional 600 feet to the higher priced location owing to the franchise of the water company preventing laying of pipes in the streets, while, on the other hand, the $1,500 site was to be reached by right of way over private property easily secured.

It does not require the expenditure of much gray matter to calculate that the profits in the operation of this plant would be considerably increased had the cheaper location been selected. But the actually amusing part of the entire transaction was when the real condition was pointed out to the owners it drew forth the fact that the matter had never been presented in this light before, and that no one who had come on the ground

to sell apparatus had discussed the advantages of location, but each had contented himself with extolling the merits of his own machinery.

It seems almost incredible that such a thing could happen and yet the facts remain as given.

There is another station, this time erected by those who were in a position to have known better, from which arc and incandescent lights and power are furnished, calling for a constant service which is obtained from a 650 horse-power Corliss engine, belted directly to a single length of line shafting, from which all the dynamos are driven. Judgment was used to the extent of putting clutch couplings to shut off one-half of the shafting at a time and clutch pulleys for the dynamos.

This station was located three miles from the load for the express purpose of taking advantage of an ample water power, which was to be developed by a water power company, so there was ample room for a building for two or three engines of smaller units and for better arrangement of line shafting, but it was *cheaper* to build for one engine, and, on the argument "we will soon have ample water power for the greater part of the year," the plant was laid out "on the cheap."

In spite of the fact that there was to be an ample supply of water eventually and a sufficient supply at hand for temporary use, there was no consideration of the saving to be made by use of compound condensing engines.

The results are that the water supply can only be depended upon for operating for a part of the year and not then to drive the entire plant. Coal has to be hauled for an even mile from the railroads over bad roads, while the total line loss is a very high percentage on the output of the station.

Foresight in this case would have resulted in a very great increase in the profits to be made in this enterprise, but, unfortunately, every consideration was lost sight of in the effort to cut down the first cost of the plant, a proceeding which is usually the shortest sighted policy which can be followed.

A final illustration of the mistakes made in location and building of large plants may be interesting. This plant was planned and outlined on the basis of being a "model plant." Its location is a good one, and evenly balances up the various factors which should be considered, as to coal, water and loss on lines. Its boilers, engines and electrical equipment are the very best that money could buy, as no pains were spared to make it a paying property from the start.

Where, then, is "the colored boy in *this* woodpile?"

A tremendous growth, a rapid growth, far ahead of what the promoters of the company contemplated, and now they are cluttered up in a vain effort to meet the demand upon the station by working in a dynamo and engine here and another there, and afterwards one between the two, until it is almost impossible to get about. Boiler and steam pipe capacity are indequate to meet the demands, and cannot be increased without enormous expense or the shutting down of the plant.

But the worst feature is that this expensive plant is so located on the property that it cannot be enlarged in the direction which would allow of the increase of the machinery and extension of the plant on the same plan as at present without purchase of property held at double its real value.

To be sure, the plant can be extended in the other direction, but this would make it necessary to either change the arrangement of every boiler, engine and machine in the present station, or to put up a duplicate of the present station on the next lots and operate it with a duplicate force of men. This would mean the throwing away of the profits to be made by the increased load, which could be taken care of by fewer men and a general reduction all around.

As a result, this company is at a standstill, so far as its adding to its load goes, and all the new business is going to a company which has extended its lines into the territory from which they were practically excluded as long as the first one could handle the increasing business.

But these are all illustrations of the larger plants, some of them constructed by men who should have known better from past experience. When we look over the conditions surrounding so many of the smaller plants, which seem to have been thrown together without any regard to the elementary conditions of engineering, electrical or mechanical, words fail to properly describe their miserable botched up condition.

The bane of electrical work has been that so much of it has been done in a temporary manner. This subject of temporary work

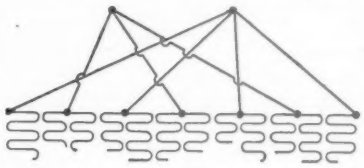


Fig. 1.

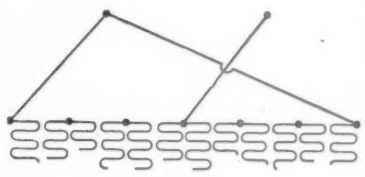


Fig. 2.

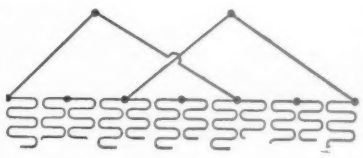


Fig. 3.

CONNECTIONS OF PLATES IN THE CARPENTER ENAMEL RHEOSTAT.

in general will be fully discussed in a later paper; here I will only urge the growing necessity for the location and erection of buildings for electrical plants with a view to permanency. In this way only can much useless and costly moving of machinery be avoided as the load upon the plant is increased. If we have before us an ideal location it will be easier to decide as to the best one of several sites presented for the plant.

It is almost impossible to secure an ideal location, but if we have one before us it is easier to accomplish the selection of the best; it is, therefore, well to bear in mind that the chief elements in an ideal location are one central with reference to the loads to be carried and the centers of distribution, with small losses in feeders and mains, without excessive cost of copper, a good water supply for boilers, condensers, etc., and a good storage for fuel, with short or no haulage from water or railway.

We rarely find all of these conditions in one place, but by carefully balancing those we have at hand in our selection, we secure the most advantageous location.

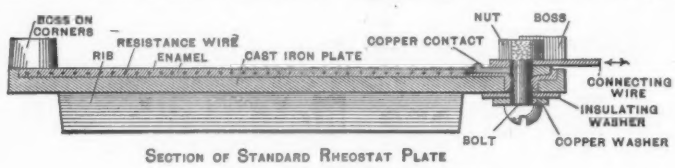
To sum up the question under discussion, therefore, it seems that the following should be the points to be carefully considered:

The site to be selected with a view of its being the permanent location of the plant, with ample space in which to extend the buildings when necessary, and with a view to balancing the percentage of loss between the various elements of coal, power, water and copper, as all of these play a very decided part in the dividend earning capacity of the station.

(To be continued.)

The Carpenter Enamel Rheostat.

The Carpenter Enamel Rheostat Company, of Bridgeport, Conn., was organized for the purpose of manufacturing rheostats and similar apparatus under United States patents granted to Charles E. Carpenter, chief among which is patent No. 447,023, of



SECTION OF STANDARD RHEOSTAT PLATE

THE CARPENTER ENAMEL RHEOSTAT.

February 24, 1891, the leading claim of which reads as follows:

"In an electro heating apparatus, the combination with the heated surface plate and the resistance, of a coating of enamel or its equivalent securing the resistance to, but insulating it from, said plate."

The company is also owner of various other inventions pertaining to the same subject, and has a large number of applications for patents pending, covering important details in the apparatus.

The principle of this rheostat is the conduction and dissipation of heat by holding a resistance wire in close relation to a metal plate so that the heat generated in it, by the passage of a current, is rapidly conducted to the plate, which becomes the radiating surface. This is accomplished by the use of an enamel which permanently attaches the wire to, but insulates it from, the radiating surface plate, and which also completely surrounds and protects the wire from chemical action. In this way the current capacity of a resistance wire for current is greatly increased. In practice it is said to be found that a wire that will carry a certain current when exposed to the air will carry 10 times that amount of current safely in this rheostat. On this principle, since the cross section of the conductor can be greatly reduced, it follows that its length can be also proportionately shortened for any required resistance, and no consideration of mechanical strength of the wire enters into this construction since it is so perfectly confined and supported on all sides. For example: A 24 B. and S. German silver wire will, in this rheostat, carry 25 amperes and 80 feet of the wire coiled upon the surface of a plate, 10x10 inches, will absorb and dissipate five kilowatts of energy in starting a five kilowatt motor of 220 volts under full load.

To increase the radiating surface, the back of the plate is provided with ribs for extending its radiating surface. The plates will dissipate continuously eight watts per square inch of one surface, *i. e.*, 10x10 inch plate,

FIG. 4.—THE CARPENTER STANDARD RHEOSTAT.

or 100 square inches, will dissipate 800 watts. The temperature of the plate dissipating energy at this rate will be entirely safe, as it will not char wood or similar materials when operating under this condition.

The watts are the product of the square of the amperes into the ohms (*i.e.*, watts = C^2 R), and so long as this product is kept constant we may vary at pleasure the relation between the amperes and the ohms; thus, on a 10x10 plate a wire may be used of two ohms resistance, with 20 amperes capacity, or it may be 50 ohms and four amperes, etc., so long as C^2 R = 800.

These plates will carry for a few seconds when used as a motor starting rheostat, and for similar purposes, a current two and a half times as large as that for which they are rated for continuous service; that is, they will safely dissipate for, say, 15 seconds six and a quarter times as many watts as they are rated for in continuous duty.

For convenience in rapidly supplying orders these plates have been standardized, and standard sizes are always carried in stock. Standard plates are rated for continuous duty on the basis of four amperes per kilowatt when used as a starting rheostat for a 220 volt motor.

The standard plates have always an even number of steps, and, by connecting in various ways, various resistance and current capacity may be obtained. For example, Plate No. 1, having 40 ohms, with capacity for 5 amperes and 6 steps, has 6.6 ohms per step; by connecting as indicated in Fig. 1, we secure a plate having a capacity of 30 amperes and 1.1 ohms. The second arrangement (Fig. 2) gives for plate No. 1 a capacity of 10 amperes and resistance of 10 ohms; the third arrangement (Fig. 3) of plate No. 1 gives 15 amperes capacity with 4.4 ohms.

Special plates can be furnished as large as 10x15 inches of any shape desired. Rheostats are also made for use as stage regulators, feeder equalizers, resistances for large motors and for constant potential arc lamps.

Fig. 4 shows a standard Carpenter rheostat. It will be noticed that the same iron plate which carries the switch contacts and lever has the coating of enamel on its under side, with the wires embedded in the enamel so that the rheostat occupies an extremely small space; no more than the switch part alone of existing rheostats, without the coils. The fire-proof and water-proof qualities will be evident from the illustration, as well as its compactness, mechanical strength and simplicity.

The advantages claimed for the Carpenter enamel rheostat are as follows:

First. It is fire-proof, as no combustible material enters into its construction, and it can never be submitted in normal use to a temperature as high as that to which it is subjected in the process of manufacture.

Second. It is durable, since the resistance wires cannot deteriorate, from oxidization, electrolysis, etc.

Third. It is compact, as it requires less than five per cent. of the cubic space required by the ordinary coiled wire rheostat of the same capacity.

Fourth. It is simple, the three necessary elements—resistance wire, insulation and radiating surface plate—being fused into one integral mass.

Fifth. It is cheap, for a certain resistance and carrying capacity can be obtained by the use of a wire whose cross-section and length will both be but one-tenth of that required for a wire used in the air. That is, the total weight of wire, and hence the cost of the same, will be but one per cent. of that usually required.

Sixth. It is unaffected by heat, cold, acids, alkalies, oils and other chemicals, and for this reason is especially adapted for use in mines, breweries, marine vessels, etc., where chemical action rapidly destroys ordinary insulations. It is even practical to operate these plates submerged in flowing water, in case it is desirable to carry off the heat in this way.

The Niagara Falls Tunnel.

Chief Engineer Porter says that the big power tunnel will be completed before October 1, and that it is probable water will be let into it by that date. The other work is progressing rapidly. On Saturday, August 20, a meeting of the officers and engineers of the Cataract Construction Company will be held at Niagara Falls. Professor Forbes and Professor Unwin, of London, England, will be present. The particular business to be considered is the development of power on the Canadian side and the transmission of power to Buffalo.

The Association of Edison Illuminating Companies.

REPORT OF THE THIRTEENTH CONVENTION, HELD AT TORONTO, ONT., AUGUST 9.

FIRST SESSION.

The eighth annual meeting (thirteenth convention) of the Association of Edison Illuminating Companies met in Toronto, Ont., at the Rossin House, on Tuesday, August 9. The first session was called to order at 2.30 o'clock, by John I. Beggs, who has been for the past six years president of the Association. The following members were present:

W. M. Brock, general manager Edison Electric Illuminating Co., Paterson, N. J.
A. F. Walker, superintendent E. L. Co., Grand Rapids, Mich.
W. S. Barstow, general superintendent Edison E. I. Co., Brooklyn, N. Y.
Wilson S. Howell, treasurer of the Association, and honorary member.
Frederic Nicholls, president Toronto In. E. L. Co., Toronto, Canada.
C. L. Edgar, general manager E. E. I. Co., Boston.
J. H. Vail, assistant engineer in chief General Electric Company, New York.
J. A. Colby, secretary and manager Edison Light Co., Des Moines, Iowa.
F. E. Jackson, Edison Lamp Works, Harrison, N. J.
W. L. Garrison, treasurer E. E. I. Co., Brockton, Mass.
George R. Stetson, president New Bedford Gas and Edison Light Co., New Bedford, Mass.
Charles R. Price, treasurer New Bedford Gas and Edison Light Co., New Bedford, Mass.
William D. Marks, president Edison Elec. Ilg. Co., Philadelphia, Pa.
J. H. McClement, president Edison Electric Light and Power Co., Amsterdam, N. Y.
Winston-Salem Railway & Electric Co., Winston-Salem, Va.
Arthur Williams, general inspector Edison Electric Illuminating Co., New York City.
Arthur E. Kennelly, Edison Laboratory, Orange, N. J.
A. L. Smith, president Appleton Edison Electric Co., Appleton, Wis.
Charles Wustenfeld, manager Elgin City Railway Co., Elgin, Ill.
Hoyt Post, director and attorney Edison Electric Illuminating Co., Detroit, Mich.
C. P. Gilbert, secretary and manager Edison Electric Illuminating Co., Detroit, Mich.
E. R. Weeks, general manager, Edison Electric Light & Power Co., Kansas City, Mo.
S. B. Eaton, general counsel Edison Electric Light Co., New York City.
G. H. Van Etten, Edison Electric Light & Power Co., Little Rock, Ark.
J. E. Sayles, general agent Edison Electric Illuminating Co. of New York.
Charles H. Lindenberg, Columbus Edison Electric Light Co., Columbus, O.
A. W. Field, secretary and manager Columbus Edison Electric Light Co., Columbus, O.
Samuel Insull, president Chicago Edison Co., Chicago, Ill.
W. J. Jenks, Edison Electric Light Co., New York City.
George H. Finn, secretary, treasurer and manager St. Paul Edison Co., St. Paul, Minn.
Maurice Hoopes, superintendent Edison Electric Illuminating Co., West Chester, Pa.
W. E. Rundle, official stenographer, John I. Beggs, director, Harrisburg Electric Co., Harrisburg, Pa.
Renovo Edison Light, Heat and Power Co., J. H. Sheddy, general manager.
A. D. Page, assistant manager Edison General Electric Co. lamp works, Harrison, N. J.
John R. Markle, director Edison Light Co., Grand Rapids, Mich.
John Langton, Canadian works Edison General Electric Co.
Henry W. Darling, vice-president Newport Illuminating Co., Newport, R. I.
H. J. Smith, general operating superintendent Edison Electric Illuminating Co. of New York.
M. D. Barr, district manager Edison General Electric Co., Toronto, Ont.
Edwin W. Hammer, Edison Electric Light Co., New York city.
C. R. Van Trump, engineer and manager Wilmington City Electric Co., Wilmington, Del.
W. S. Andrews, general superintendent Canadian works Edison General Electric Co.

The standing committees of the Association were called upon for reports, and from these reports several discussions of practical subjects resulted. These included the importance of high insulation in the interior wiring of buildings and the improvement of safety fuses. On several of these questions the Association was favored with a practical talk by Capt. William Brophy who, by vote of the meeting, was specially invited to be present and participate in the discussion.

Mr. J. H. McClement raised some interesting questions relative to the possibilities of operating electric railway systems, and during the discussion Mr. William Lloyd Garrison, of Boston, was called upon and gave, in an exceedingly interesting manner, some results of his pioneer incandescent electric light experience at Brockton, Mass. Instructive remarks were made by Messrs. Barstow, of Brooklyn, and Mr. Stetson, of New Bedford.

By invitation of the Association, Mr. M. J. Sullivan, for several years official stenographer of the Association, read a paper entitled "The Central Station and Street Railways," which commanded the close attention of the delegates and occasioned further discussion on the questions suggested.

An interesting and valuable paper, illustrated by statistical tables and diagrams, was read by Mr. J. H. Vail, on "The Application of New Apparatus and High Economy Engines in Central Engines to secure Greater Commercial Efficiency and Economy of Coal."

SECOND SESSION.

Returning from a delightful drive through the suburbs of the city, in open carriages provided by the Edison Company of Toronto, the Association convened at 11 o'clock A. M., August 10.

The courtesy of the Edison Company in arranging for this early morning ride and the moonlight sail of the previous evening, was suitably acknowledged by vote of the Association.

The Canadian Department of the General Electric Company offered to the delegates the pleasure of an excursion to the Peterborough factories, but as the business engagements of the majority of the members of the Association prevented any general attendance upon such an excursion, the invitation was declined with regrets and thanks. The principal feature of the day's programme was a discussion of important questions of business policy.

In the afternoon the discussions of the morning were continued, Mr. C. A. Coffin, president of the General Electric Company, and Mr. S. B. Eaton, general counsel of the Edison Electric Light Company, being present and participating.

The following officers were chosen for the year to come: President, John I. Beggs; vice-president, Frederic Nicholls; secretary, W. J. Jenks; treasurer, Wilson S. Howell. Executive Committee, C. P. Gilbert, C. L. Edgar, E. R. Weeks, W. D. Marks, Samuel Insull.

The question of the place of holding the next annual meeting was left to be decided in future by the executive committee.

A statement regarding the work which has been done during the year by the fuel gas committee was made by J. R. Markle. The committee was continued for another year, as were also the committees on lightning protection, dangers from systems of high pressure and grounding the neutral wire.

General Notes.

Boston's fire department is to have underground cables for its service in the crowded portion of the city.

The Edison Electric Illuminating Company of Boston has declared a quarterly dividend of two per cent., payable August 1, to stock of July 19.

The New England Telephone and Telegraph Company, in Lawrence, Mass., has commenced work upon laying underground conduits for its wires, permission for which has been granted by the city government.

The ordinance to grant the Ohio Telephone and Telegraph Company the right to construct and operate telephones and telegraphs along certain streets of the city of Toledo, O., was passed with some slight amendments.

The Vandalia, Mo., electric light plant was destroyed by fire recently. It was the property of E. G. Bucklin, and the loss is estimated at $9,000; insurance, $4,500. The fire caught from cinders after the plant was closed down. It will be rebuilt at once.

At a recent meeting of the directors of the New England Telephone and Telegraph Company, a dividend of 75 cents per share was declared payable on Monday, August 15, 1892, to stockholders of record at the close of business on Saturday, July 30, 1892.

The Providence Telephone Company has submitted to the city council there a proposition to bury the electric wires in conduits throughout the city, the plant costing about $300,000, and covering territory of four miles. The city electric wires would be placed therein without cost.

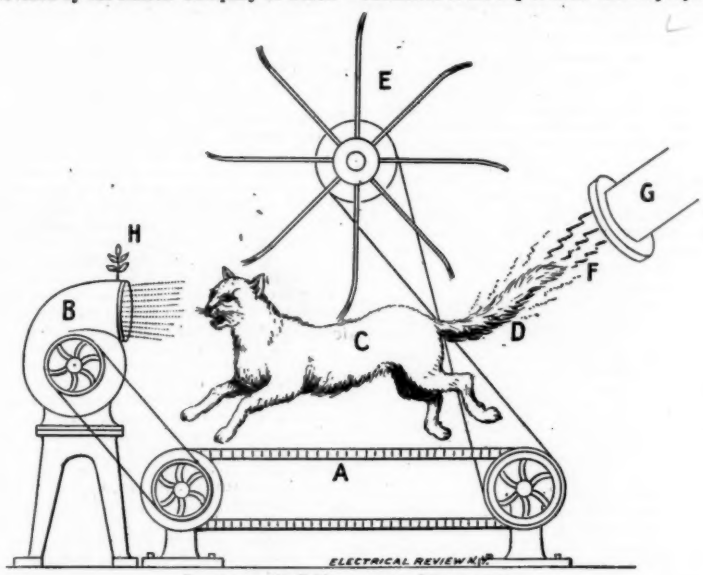
Bell telephone's instrument output for the month ending July 21 shows:

	1892.	1891.	Increase.
Gross output	7,779	4,699	3,080
Returned	5,066	4,638	428
Net	2,713	61	2,652
Since Dec. 20.			
Gross	57,903	41,993	15,910
Returned	31,676	23,399	8,277
Net	26,227	18,594	7,633

The Sunset Telephone Company, of Oakland, Cal., has decided to place all its wires underground. This work will cost $40,000. The company is also soon to begin the erection of a new building which will cost $12,000, and will be located close to Broadway, between Tenth and Fourteenth streets.

A supposed incendiary fire broke out in the morning of August 7 in the upper shops of the National Tramway and Electric Light Company, at Victoria, B. C., which quickly spread to the power house adjoining, and in two hours the whole plant, valued at $200,000, was completely destroyed. The insurance does not exceed $50,000.

News is received from Vienna that a German company has asked the Minister of Commerce for a concession to convert the Baden Steam Tramway into an electric line. It is proposed to extend the line and also to connect the stations of Baden and Vöslau. The generating station would also be arranged so as to supply current for the electric lighting of the town.



SPAULDING'S CATELECTRIC APPARATUS.

Spaulding's Catelectric Apparatus.

THE NEW ENGLAND CATELECTRIC COMPANY ACQUIRES THE INVENTION AND WILL EXPLOIT IT.

TO THE EDITOR OF ELECTRICAL REVIEW:

I desire, through your valuable columns, to correct an impression existing in the minds of some that I have abandoned the field of electrical engineering, at the same time calling attention to a new machine of my own invention, which will, undoubtedly, work a revolution in isolated plant lighting and power generation. The great advance steps in electrical science have been made in the adaptation of simple laboratory experiments to practical service, and the value of my device will be instantly appreciated by those versed in the art.

Referring to the illustration of the apparatus as at present constructed, *A* represents a revolving platform or treadmill, suitable for operation by one or more domestic cats, such as may be obtained in the back yard fastnesses of our large cities or Lynn. Under the inspiring influence of a bunch of catnip *H*, and refreshed by an air blast from the blower *B*, these animals furnish power for revolving the shaft carrying the rubbing wheel *E*, the flexible radial arms of which are of light bamboo or wicker-work, covered with silk.

The entire portion of the machine so far described is mounted on insulated feet, and by the adjustment of the condenser *G*, in relation to the terminal *D*, a constant spark is maintained by the passage of the current generated.

The application of this machine for lighting and power purposes is a mere matter of de-tail and with one or two improvements, which will be introduced in the standard apparatus, their rapid introduction upon the market is assured. The New England Catelectric Company has been organized, and a syndicate of prominent men has already secured an option on a majority of the stock. The action of the present experimental machine is somewhat kittenish at times, and care must be taken not to hurt its felines, but with ordinary attention it should last for years in any well populated neighborhood. State and county rights are now for sale and all inquiries will be cheerfully answered by yours respectfully,

H. C. SPAULDING.

Exeter, N. H., August 10, 1892.

How Cyrus Laid the Cable.

In *Harper's Weekly* of September 11, 1858, there appeared the following capital ballad from the pen of John G. Saxe, Green Mountain poet. It is worthy of reproduction at this time:

Come, listen all unto my song;
It is no silly fable;
'Tis all about the mighty cord
They call the Atlantic cable.

Bold Cyrus Field, he said, said he,
"I have a pretty notion.
That I can run a telegraph
Across the Atlantic Ocean."

Then all the people laughed and said
They'd like to see him do it;
He might get half-seas over, but
He never could go through it.

To carry out his foolish plan
He never would be able;
He might as well go hang himself
With his Atlantic cable.

But Cyrus was a valiant man,
A fellow of decision;
And heeded not their mocking words,
Their laughter and derision.

Twice did his bravest efforts fail,
And yet his mind was stable;
He wa'n't the man to break his heart
Because he broke his cable.

"Once more, my gallant boys!" he cried;
"Three times:—you know the fable"—
"I'll make it thirty," muttered he,
"But I will lay the cable."

Once more they tried—hurrah! hurrah!
What means this great commotion?
The Lord be praised! the cable's laid
Across the Atlantic Ocean!

Loud ring the bells—for, flashing through
Six hundred leagues of water,
Old Mother England's benison
Salutes her eldest daughter.

O'er all the land the tidings speed,
And soon in every nation
They'll hear about the cable with
Profoundest admiration!

Now long live James and long live Vic,
And long live gallant Cyrus;
And may his courage, faith and zeal
With emulation fire us.

And may we honor evermore
The manly, bold and stable,
And tell our sons, to make them brave,
How Cyrus laid the cable.

Problems of Commercial Electrolysis.

READ BY J. SWINBURNE, BEFORE THE INSTITUTION OF ELECTRICAL ENGINEERS, LONDON.

It would be idle to attempt to go over the whole subject of the technical applications of electrolysis, as, although this development of industry is of very recent growth, it is already so extensive that many of its branches demand evenings devoted exclusively to their discussion. My object is, however, to take a sort of bird's-eye view of the subject, and, if possible, to try to foresee the directions in which others must seek for future developments.

There is a very general feeling that there is a mine of untold wealth in the application of electricity to metallurgy; but chemists are not generally electricians and electricians are seldom chemists. It seemed, therefore, advisable to bring the paper before this Institution, in the hope that it will result in a discussion; and if it leads to the expression of the views, both of electrical engineers and manufacturing chemists, and to a further approach to common ground, our time will be well spent.

However puzzling the theory of electrolysis may be, for commercial purposes it may be regarded as involving no mystery. In fact, broadly speaking, we may disregard the electrical side of the question and look upon electrolysis as a method of oxidizing and reducing, and nothing more. It must be remembered, however, that there are often many ways of oxidizing the same substance. For instance, a sulphide may be oxidized into a sulphite or sulphate, or sulphur may be liberated. Electrolysis does not always afford the means of oxidizing in the particular manner desired. A very large number of the processes employed in chemical industry consist merely in oxidizing and reducing, special conditions being arranged to suit the particular substance being operated upon. Once we take this broad view, all we have to consider is: "Which of the oxidizing and reducing processes in use in chemical works can we advantageously replace by electrical methods?" In many cases electrical methods are impossible; in others they are more expensive than those at present in use; but it is hardly too much to say that in an enormous number electrolysis is destined to play a leading part in the near future.

Take, for instance, the case of reduction. This is almost universally effected by means of hot carbon, and at first sight it seems unlikely that it could pay to burn the carbon under a boiler and get a small percentage of the energy back in the electrical form and to utilize that portion alone. It must be remembered, however, that the methods of reduction by burning carbon are themselves, exceedingly inefficient, and, moreover, they very often give impure products. By means of electrolysis, however, it is frequently possible to secure metals of the highest purity by direct processes. Before going further, it will be wise to form some idea of the cost of electrical energy in, say, a large chemical works. Of course "cost" is a loose term; we might calculate it from the cost of coal and labor and sundries; or we might add interest and depreciation, rent and superintendence. In all cases in estimating the cost, further additions have been made for standing charges, advertising, profits, maintaining patents, etc. It is unnecessary to trouble ourselves about definitions of cost, for if it is stated how the figures are obtained, the selling price can be worked out and comparisons can be made.

Suppose a plant is put up to give a million watts; it will be found that if the plant is taken as running day and night, including Sundays, and if the best engines with modern dynamos are employed, the cost comes out about 0.25*d.* per kilowatt hour. This figure includes interest and depreciation of engines, boilers and buildings, and coal, labor and petty stores; but does not include rent or salaried superintendence. This figure will appear ridiculous to those accustomed to London central stations; but that is because central stations work under the most disadvantageous conditions possible, while a chemical works has everything in its favor.

OXIDATION AND REDUCTION.

Oxygen.

The first obvious application of electrolysis is the decomposition of water. In an acid solution platinum or lead anodes are necessary; platinum is expensive and lead takes a high electromotive force, so it would be best to use an alkaline solution with iron electrodes. Allowing two volts as the pressure required, the cost comes out at 5*s.* 7*d.* per 1,000 feet for the oxygen. The hydrogen is taken as valueless. As the output in oxygen must be small, we must take a much higher figure than the farthing per kilowatt hour—in fact, it would be safer to double the price and say 11*s.* 2*d.* To find the selling price we must allow for packing in cylinders and add all the trade charges, which will probably bring the price up to something like 15*s.* per 1,000 cubic feet. The retail price of Brinn's oxygen is 2*d.* per cubic foot, so there would appear to be a very large margin.

Alkali.

We come next to a subject which has already absorbed an enormous amount of labor and thought, and that is, the production of caustic soda and chlorine from common salt. The Leblanc and Weldon process is exceedingly complicated and very costly; and as by simply electrolyzing salt, costing about 15*s.* a ton, chlorine and caustic soda can be produced, it seems, at first sight at least, most strange that electrolytic processes have not replaced all others within the last few years. Assuming that the process works, let us first form a rough idea of its probable economy. With suitable vats and a reasonable current density, we may take it that three volts is a liberal allowance. For the ton of 70 per cent. caustic soda we have:

	£.	*s.*	*d.*
Electrical energy.....	2	15	0
Salt.....	1	2	6
Lime.....	1	8	0
	£5	0	6

For £5 we have thus obtained a ton of caustic and one and one-half tons of bleaching powder. We have allowed nothing for the cost of vats, for labor at the vats and in handling, or for evaporation of causticized liquor. The ordinary caustic liquor after causticizing is quite weak, but electrolytic caustic can be made into a strong lye. On a small scale I have produced lye with 30 per cent. caustic. To do this the brine is electrolyzed and then stirred up with more salt, and so on; the process being repeated several times. Strong caustic is a good conductor, so this method is good from that point of view as well as from that of saving in evaporation. Evaporation with a Yaryan should not come to more than a shilling or two a ton extra. It would doubtless be safe to say that, taking this way of estimating the cost, a ton of caustic and a ton and a half of bleach should be made for £6. This allows an enormous margin for expenses and for profits. This method of estimating is very rough, and unless a new process worked out in this sort of way comes out with an enormous margin, it is not likely to be worthy of serious consideration. On looking into it further, it will generally be found that when all the details of expenditure which will be necessary in practice are added, the margin, if it still exists, is too small. In fact, a new process must look marvelously good on paper to be really worth anything when tried commercially. Electrolytic soda and bleach seems to have an excessive margin, however, and we have to see whether there is any other weak point.

I believe the difficulty, and the only difficulty, lies in the anodes. Process after process is brought out, and each claims to have solved the problem of electrolytic soda by the use of some new arrangement of the porous partition, or by some other detail which can hardly make all the difference between success and failure. The various processes make a little excitement for a time and then disappear, I believe because the anodes are destroyed.

Of course, none of the ordinary metals can be used as anodes, as they are attacked at once. Platinum is generally supposed not to be attacked by chlorine; but I find that it is slowly eaten away. I would like to hear this confirmed or denied by others, for it is a very important point. On the one hand I find experimental anodes eaten away; on the other we hear of platinum anodes being used extensively in the electrolysis of chlorides. Of course, in the manufacture of such a cheap commodity as soda, the capital invested in platinum anodes would be prohibitive; and the least waste of metal would lead to ruinous expenditure. The next material to consider is carbon. In 1882 Bartoli and Papasogli pointed out that carbon was attacked when used in any solution which evolves oxygen. Without knowing of their work, I found the same thing by a series of experiments carried out in 1883. In those days it was tacitly assumed that carbon with peroxide of lead could be used in the ordinary secondary batteries, without any fear of local action. Though carbon does not seem to combine with chlorine during electrolysis, I find that it is always attacked, even in a solution of salt. I have tried every kind of carbon I can think of, and the result has always been that the anode was corroded. I do not mean to say that carbon is eaten away at a rate at all corresponding to that with which the soda is formed; in comparison the corrosion is slow. It must be remembered, however, that a very slow corrosion makes carbon anodes useless when the products are cheap.

Carbon is also troublesome mechanically. It is difficult to make good contacts with it, especially when there is chlorine about. Large carbon plates are also expensive. Mr. Greenwood overcomes this last difficulty by electroplating one side of a number of comparatively small plates, and then soldering them to a plate of type metal. The type metal is not exposed to the solution anywhere, else it would be attacked by the chlorine. By this means he produces a large carbon anode with a good metallic connection.

Peroxide of lead seems to present a solution of the problem. Unfortunately, however, peroxide of lead is reduced by hydrochloric acid; and it seems to be impossible to electrolyze salt without producing some free acid at the anode. Some specimens of lithanode I tried were attacked; I do not know, though, whether the inexhaustible ingenuity of Mr. Fitzgerald has produced any special make which will stand traces of free acid. I am inclined to think, therefore, that progress is barred in this direction solely by the want of a good anode. If this is the case, there is a fortune awaiting the inventor who can find something which will act as an anode in a solution of common salt.

I have tried electrolyzing sodium sulphate. There is not the same margin here. You get hydrochloric acid as a by-product instead of chlorine, so that the Weldon process would still be necessary, and the sulphuric acid would have to be concentrated every cycle in order to act on the next batch of salt. This process would, in fact, save the black ash part of the soda process, and, like all these methods, would demand carbonic acid to make soda crystals. Of course, this last is not a serious difficulty, especially if quicklime is needed to absorb the chlorine. In this case I tried lead anodes, when, to my surprise, the small traces of chlorine left in the sulphate corroded the lead anodes.

Papermakers use large quantities both of caustic and bleach, and they recover soda and causticize it on their works. It would, therefore, be an enormous advantage to be able to produce caustic and bleach direct on their own premises. I do not know if the presence of salt would interfere in any way with the action of caustic in the grass or straw boilers, but should think not. By making the caustic on the spot, a saving is effected in the processes otherwise necessary. There would be no need to concentrate the lye, or to fish out the salt that may be present. Caustic drums and carriage would be saved; but, of course, against this there may be carriage of salt. The importance to paper works is so great that it is almost a question whether it would not pay to face the corrosion of the carbons and to arrange vats so that the anodes can be easily replaced.

In the Hermite process the chlorine is not given off, but a hypochlorite is formed. Of course, in this case caustic soda cannot be made. For paper works especially it is obviously cheaper to supply lime and get bleaching powder and caustic, than to make sodium hypochlorite only. This may, however, depend on the anodes. Platinum anodes are used in this process, and it seems to be the case that platinum is not attacked in an alkaline chloride. If this is so, it is possible to produce hypochlorite of soda, but not caustic and bleaching powder. The Hermite process is apparently commercially successful. Magnesium chloride is generally employed in the Hermite process, but I have been told that salt is now used. It has been said that electrolytic hypochlorites, especially of magnesium, have more bleaching power than the ordinary bleaching powder. Of course, a sodium, or any other hypochlorite, may be formed which has twice as much of its chlorine available, when compared with bleaching powder; but this is merely an apparent gain, as it takes twice as much electricity to produce the hypochlorite. Messrs. Cross & Bevan, however, hold that the bleaching power of these compounds is not as determined by arsenious acid. They maintain that the fibres to be bleached contain some ketones or other, and these ketones absorb some of the available chlorine, especially when provided by bleaching powder; that the hypochlorite of sodium and of calcium waste available chlorine on the useless work of chlorinating these ketones, while magnesium hypochlorite devotes its whole attention to honest bleaching. Of course, if it is slightly easier to oxidize the coloring matters than to attack the ketones, it may be the case that a hypochlorite of a weak base, like magnesium, may be able to bleach, but not to attack ketones. It would then be better than the hypochlorite of calcium or especially sodium. These matters are better left in the hands of such authorities as Messrs. Cross and Bevan. They make out, also, that electrolytically prepared magnesium hypochlorite is best. This seems very strange. Of course, it would mean that some other salt is really formed. The properties of a salt cannot depend on the method of its preparation, and there is no magic in electrolysis.

POTASSIUM CHLORATE.

The manufacture of potassium chlorate is carried out by electrolyzing a hot solution of the chloride. The chlorate is then formed instead of the hypochlorite. This process is carried out on a large scale at Vallorbes, in France, under the direction of M. Gallde-Montlaur. It is stated that they make a ton a day, 24 horse-power hours, yielding 2.2 pounds. The power is supplied by a waterfall, so the chlorate should be very cheaply made, if the anodes are absolutely free from corrosion. Platinum anodes are employed.

THE ELECTROLYSIS OF FUSED SALT.

Many inventors have been at work on electrolysis of fused salt. At first sight this also seems most simple. Salt is cheap and is fusible, and, therefore, all that has to be done is to melt it and electrolyze it, getting sodium at one pole and chlorine at the other. The sodium could be sold at a very low price for making aluminium, and for amalgamation in gold extraction, and can, of course, be converted into caustic soda or crystals as desired. Consumers of caustic would buy the metallic sodium, and would add water, thus obtaining pure caustic. The margin of profit in this case is apparently enormous.

The difficulties are, however, very serious. In the first place, sodium chloride boils at a very little above its melting point. The result is that the sodium is obtained mixed with large quantities of salt. Melted salt is by no means a convenient substance to handle. It acts on many kinds of clay, so that ordinary fire clay crucibles cannot be employed. Chlorine at a temperature corresponding to a red heat is also troublesome to deal with. It is said that chlorine will not attack a dry metal, so that iron can be used for the containing vessel. Most patentees describe vessels of iron with porcelain where insulation is necessary.

We now come to the anodes again. As there is no oxygen present, it would seem as if carbon might be used. Patentees always mention carbon anodes. Retort carbon is eaten away, and so are electric light or artificial carbon rods.

It seems strange that carbon should be attacked, and it would be well for these experiments to be repeated, to make sure that there is no error. Of course, carbon is the only hope. Whether the chlorine is dry or not, metals are eaten away with great rapidity. The anodes are corroded chiefly at the surface. In addition to these troubles, the theoretical quantity of sodium is not obtained. Some people have supposed that there is a sub-chloride formed, and that sodium is really not a monovalent metal. This is rather an extravagant notion. I do not know why both sodium and chlorine should not be soluble in the fused chloride without forming any definite compound. So many workers have been unsuccessful with fused salt, that it looks as if there were some insuperable obstacle in the way; and it is questionable whether the ground is worth any further labor.

ELECTROLYSIS OF FUSED SODA.

Castner has recently proposed to produce sodium cheaply by the electrolysis of fused caustic. The temperature is to be high enough to fuse the caustic, but not high enough for the sodium to decompose the fused hydrate forming oxide. Whether this process has had any success commercially I do not know.

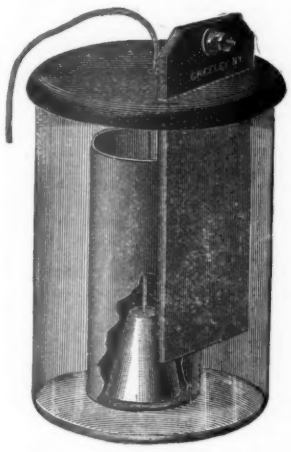
ALUMINIUM.

The extraction of aluminium has long been an important problem. The old method was to replace aluminium in its chloride by means of sodium. This involves the manufacture of metallic sodium, and of the anhydrous chloride of aluminium. The anhydrous chloride cannot be obtained by evaporation of its solution, as the solution gives off hydrochloric acid and leaves alumina, otherwise the anhydrous chloride would be quite cheap. The price of sodium has been reduced recently by the Castner process, but the extraction of aluminium by ordinary means is still so expensive that electrical methods can compete.

It seems to be impossible to deposit aluminium from any of its solutions, so fused salts have to be employed. The electrolytic processes differ in detail only. The electrolyte is cryolite, or a solution of alumina in cryolite. If cryolite is electrolyzed, aluminium is deposited and fluorine is presumably evolved at the anode, which is made of carbon. I have not seen any account of how the fluorine comes off. Yet in some processes it is stated that cryolite is electrolyzed by itself. In the Minet process the solution of oxide is employed and aluminium is deposited, and the anodes are burned away by the oxygen giving off, according to some accounts, carbon dioxide, but probably the monoxide in fact. The chief difficulties in the electrolysis of cryolite solutions are due to the cryolite itself, as it attacks all the substances commonly employed for making crucibles. It is, therefore, usual to use cast iron to make the containing vessels or vats, and to heat the electrolyte by electrical power from the inside.

Minet uses iron vats and arranges a shunt current, which makes the vats to some extent cathodes, so that they are not attacked by the electrolyte. Presumably, fluorine is soluble in fused cryolite, and attacks iron. By making it a cathode it is always coated

with aluminium, so that any fluorine is taken up in dissolving off some of this aluminium. The importance of preventing the corrosion does not lie so much in the slight saving of iron as in the avoidance of any deposit of this metal in the aluminium. The great difficulty is to get the aluminium pure, and any trace of iron reduces its value for most purposes very greatly. Minet reduces the melting point of the electrolyte by the addition of common salt. In the Hall process, carried on at Pittsburgh, the electrolyte is practically the same. Calcium fluoride is used to mix with the cryolite, or calcium chloride. The Kleiner and, I believe, the Hall processes are carried on in England. The processes have so often been fully described elsewhere, that I need not discuss them at any length here. There is still a great demand for cheaper aluminium; and there is much to be done in making it pure. Aluminium has a strong affinity for silicon, and small percentages of silicon and iron are generally present and are very deleterious.



A New Telephone Battery.

MAGNESIUM.

This metal is closely allied to aluminium, and is similar with regard to its anhydrous chloride. There is not the same demand for it, as either it does not give remarkable alloys like those of aluminium, or they have not been investigated. It is said to be made on the continent by electrolyzing the double chloride of magnesium and sodium or potassium obtained from the mother liquor after evaporating sea water. The double salt can apparently be rendered anhydrous without the formation of much magnesia.

ZINC.

Proposals have been made to deal with zinc ores electrically. The blend is to be roasted into sulphate and the solution dissolved and electrolyzed. A great difficulty arises in the deposition of the metal. It comes down in trees. Kiliani proposed to use high current densities, holding that zinc then comes down in the reguline state. Watt prefers to use acetate of zinc as the electrolyte; and alkaline solutions, such as zincate of soda, have also been proposed. I am not aware that zinc has been deposited commercially. Similar processes have been proposed for dealing with the silver-zinc alloy produced in the Parkes or Karsten desilverization process.

LEAD.

So far, little has been done in the way of dealing with lead ores electrically. It has been proposed to make anodes of galena and to work with lead nitrate as electrolyte, but I have not heard that any such process has been carried out successfully. It is hardly likely that it could, as lead forms troublesome trees in acid solutions. Any one who has worked with solutions of such salts as lead nitrate would be inclined to give up all hope of obtaining anything like a reasonably compact deposit of lead.

The extraction of silver from lead by the Pattinson process is very cumbrous and roundabout, and is, of course, expensive. Keith started a works in America for desilverizing electrolytically. He used a solution of sulphate of lead in sodium acetate as electrolyte. Though the Keith process was brought out some ten years ago, it does not seem to have come into general use. The deposit of lead, even from such a solution as sodium plumbite, is very bulky and spongy, and is difficult to deal with, as it is apt to decompose water and oxidize spontaneously during handling.

GOLD AND SILVER.

Greenwood and others have proposed to make chlorine electrolytically for catching gold by the chlorine process. As this is exactly the same problem as making bleaching powder, the same difficulties have to be overcome; so it need not be discussed further.

Mr. Crookes' sodium amalgam for making the mercury ready to seize any particles of gold, and to keep it from getting "sick," can be replaced by making the mercury itself the cathode. It is questionable whether this would be worth while, as the sodium amalgam is very convenient.

Mr. Crookes has recently brought out other electric gold processes. He finds that the particles of gold become amalgamated, and collect and get caught in the mercury, if the stamped quartz is washed in a weak solution of mercury salt, under the influence of an alternating current of small frequency. It is difficult to see how the alternating current works. Unless the current density or the resistance of the electrolyte is something fabulous, there cannot be any current in the small particles of gold, as the minutest polarization would make all the electricity flow by the electrolyte, and not by the little pieces of gold, even though they are very much better conductors.

ELECTRO-METALLURGY OF COPPER.

Electrolysis may be employed either in connection with the extraction of the copper from its ores, or in refining copper, especially when there is silver alone, or with gold in addition, to be extracted.

In the first case—that of extraction of copper from pyrites—the ore may be converted into matt, and the matt can be cast into anodes, or the ore may be acted on by oxidizing solutions produced by electrolysis, or the two processes may be combined.

In the first method the matt is cast into anodes, which are treated in baths of copper sulphate with copper cathodes. The sulphides are attacked, sulphite of copper is formed, sulphur and impurities being left on the anode. The copper is deposited and iron remains in solution. The chief difficulties in connection with this process are that the anodes are brittle and troublesome, and are often eaten away unevenly, and the solution becomes richer and richer in iron salts. In addition to this, it is stated that the circulation of the iron salts must be avoided, otherwise ferric sulphate will be produced at the anode and reduced at the cathode; and this process will go on wasting power over resistance. Some sort of diaphragm is, therefore, necessary.

Fig. 1.—Improved Pull Over Bracket.

It must be pointed out that sulphuric acid can be made from the sulphur dioxide given off in the first roasting of the ores, or from the surplus ferrous sulphate. The ore can be roasted so as to give a good deal of soluble oxide of copper, which can be dissolved in the acid and treated electrically. Merely working with anodes is an incomplete process; it is better to combine it with extraction by lixivation. The solution, after being in contact with the anode, so as to contain ferric sulphate, is led to the ore. The ferric sulphate is reduced and the copper and iron are said to be dissolved, and if there is oxide of copper it is taken up by sulphuric acid. This solution is led to the cathodes, where the copper is thrown down, and is then passed to the anodes, where the iron salt is oxidized. The various impurities and the precious metals are left with the sulphur of the anode. The sulphur is burned into sulphur dioxide, which goes to the chamber, and the silver, with the gold, if there is any, is extracted. The sulphate of iron can be burned into sulphur dioxide, and the iron oxide sold as Venetian red. This is, in rough outline, the Marchese process. It may seem strange to those unacquainted with industrial chemistry that if you want to extract copper you should also become involved in making sulphuric acid and red paint; but in chemical works by-products must be utilized, so that often making one thing involves the production of a number of other substances which have, at first sight, nothing to do with it. Messrs. Siemens & Halske avoid the necessity of making anodes of matt by employing carbon. The ferrous sulphate is thus oxidized into the ferric salt, and this is used to lixivate the crushed and roasted ore. The solution is then led to the cathodes first, to take out the copper, then to the anode to oxidize it, and so on.

In the Höpfner process chloride of copper is used instead of sulphate. The action is stated to be as follows: Cupric chloride is formed at the anodes; this is led to the matt, where it attacks the copper sulphide, forming cuprous chloride and sulphur; and it is also said to dissolve the silver as well as the copper, which, if possible, would be a drawback. I do not know why the chloride should be preferred to the sulphate; and no information is given as to what is done with the sulphur in the ore, and with the excess of ferrous chloride that must be produced.

The Marchese and Siemens & Halske processes are in commercial operation, and the electric extraction of copper is already a growing industry. The electromotive force necessary for this process is less than a volt; so that, assuming coal to be used as in the estimate at the beginning of this paper, the electrical cost is 14*s.* 5*d.* per ton for the extraction of copper. I cannot give the whole cost, as that involves so many considerations. This figure will give copper smelters some idea of the saving of replacing the ordinary refining process by electrolysis.

In dealing with such a valuable substance as copper the time element must not be neglected. The interest on the money locked up in copper under treatment may be a very serious item. This is an objection of some weight in the case of matt anodes, which take some time to dissolve. The whole of the copper turned out is not obtained from the anodes; but, taken all around, it may not be far wrong to assume that the copper takes about three months to pass through the works where matt anodes are employed. If the output is, say, 1,000 tons a month, the copper represents a capital of some £150,000, and the interest increases the cost of refining some 12*s.* a ton.

(To be continued.) Jul 21. 94

Electric Launches at the World's Fair

Gen. C. H. Barney, general manager of the Electric Launch and Navigation Company, of this city, informs us that his company has been awarded the privilege of running electric launches on the lagoons of the World's Fair. A condition of the concession is that 33⅓ per cent. of the gross receipts must be turned into the Exposition Company. It is estimated that the net profits of the concession will amount to more than $300,000.

Telephones in Sweden and Norway.

There are now 5,604 subscribers to the Swedish State Telephones, against 3,176 subscribers at the end of June, 1891. The Christiania Telephone Company last year increased its number of subscribers by 376, the total number of telephones in use at the end of 1891 being 3,280, as against 2,817 the year before. During 1891 4,682,843 conversations were held through the Christiania exchange, being 1,428 conversations per subcriber per year.

LITERARY.

We have received "Reports from the Consuls of the United States," for June, 1892.

We have received "Proceedings of the First Convention of the Canadian Electrical Association," held at Hamilton, Ont., June 14, 15 and 16, 1892.

"The Port Breeze," published at Hyannisport, Mass., by Arthur C. Clark, son of J. C. Clark, the well-known telephone man, is one of the best attempts in amateur journalism that we have seen. The "locals" are extremely unique.

Edwin A. Start opens the August *New England Magazine* with a description of Gloucester, the picturesque old Massachusetts fishing port, and the beautiful Cape Ann country. The article is well illustrated by J. B. Foster, the well known water-colorist of Gloucester, Jo. H. Hatfield, Louis A. Holman and Sears Gallagher. All who have read Elizabeth Stuart Phelps' Gloucester stories will turn to this account of the old town with pleasure.

The eighth annual catalogue of the Salina Normal University, Salina, Kan., makes a most excellent showing for the school. It contains 48 pages and gives, in addition to the roll of students, faculty and courses of study, a complete description of the courses of study and full information regarding the school. This is by far the neatest and best catalogue the institution has ever sent out and should be in the hands of every person thinking of attending school.

An Electric Mine Recorder.

One of the latest applications of electricity to mining operations is seen in the Mettternich lead mine in Belgium. Each bucket that arrives at the top of the shaft makes an electric contact, and a needle in the office indicates by a red line upon a revolving drum the number of buckets brought up. By this arrangement it is possible to keep an accurate record of the regularity of the work, while the register prevents any disputes as to the quantity of material taken out of the mine.

Convention of Electric Fixture Dealers.

The National Association of Dealers in Gas and Electric Fixtures concluded its second annual convention at Atlantic City, N. J., on August 5. L. R. Cross, of Kansas City, was re-elected president; W. E. Goodman, of Milwaukee, vice-president; S. B. Dodd, of Cincinnati, secretary; John Kelly, of Pittsburgh, treasurer, and E. Baggot, of Chicago, a member of the executive committee. The next meeting will be held at Chicago in August, 1893.

A New Telephone Battery.

The accompanying cut illustrates one of the best telephone batteries yet devised for general service. It is especially adapted for use in cities where telephones are almost constantly in use and on long distance lines over which extended conversations are held. Much attention has been given to this form of battery by some of the largest telephone companies in this country, and, after many trials and exhaustive tests, it has won their expressed approval. The main features which place this type of Fuller battery in the front rank are its high efficiency, duration and uniformity of strength. The E. S. Greeley & Company, 5 and 7 Dey street, New York, are first hands.

New Railway Devices.

Electric roads having proved such a success in small towns has resulted in contracts being given for a number of large equipments in larger cities during this season. Such roads, having from 12 to 15 miles of track, found it necessary to have new and special devices for carrying the several feed wires needed. With characteristic enterprise, the Railway Equipment Company, of Chicago, has placed on the market and are now furnishing a combination pole top capable of carrying from two to seven wires. An illustration is given of the one fitted for seven wires and further illustration will be furnished by the company. We also illustrate the improved pull over bracket designed by the same company, and which has been adopted in the case of a large number of contracts given out during this season.

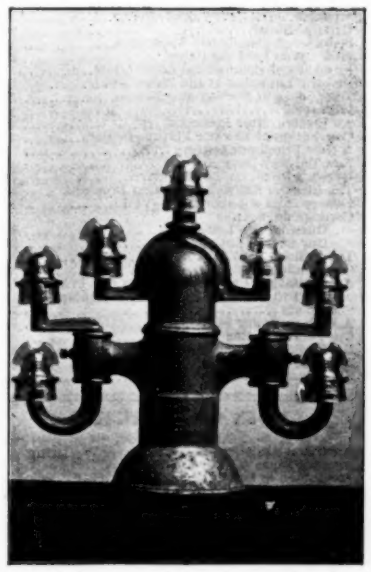


Fig. 2.—Combination Pole Top.

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HERE'S A PRIZE!

The ELECTRICAL REVIEW was among the first to apply for space in the Electricity Building of the World's Fair. Now, what shall we do with it? We have our own ideas on the subject, but in order to liven things up a bit, we make the following offer:

To the person sending us the best suggestion as to how we can most profitably exploit the ELECTRICAL REVIEW at the World's Fair, we will give a certified check on the National Park Bank, of this city, for $50.

The only conditions of the contest are that suggestions, addressed to the editor, must reach this office before November 1, 1892, and every suggestion must be accompanied by a year's subscription to the ELECTRICAL REVIEW.

The award will be made by a committee of three well known and disinterested persons.

Let's have a little mild excitement. Send a suggestion and $3 and you may get $50.

Mr. Robb MacKie's articles on "Light and Power Stations" are creating considerable interest and comment among the moths who have had their wings singed. For those about to embark in electric light and power enterprises, no better education can be suggested than a thorough perusal and digestion of Mr. MacKie's remarks. He is now dwelling upon the evils resulting from the poor selection of a station site and the examples he cites carry with them convincing morals.

"Advance Information," "Light and Power Stations," "Letters From a Laboratory," the current news of the week, addresses before technical societies and interesting correspondence from the electrical centers, are the principal features of the ELECTRICAL REVIEW during these summer days. And there is more to come. We have some other plans in store for the autumn season, which we think will be approved by our friends. The electrical brother who cannot find interesting reading in the ELECTRICAL REVIEW is requested to observe that ancient saw, "If you don't see what you want, ask for it!"

The editors of the ELECTRICAL REVIEW are pleased to know that the "Advance Information" published in every issue of the paper is proving of great value to our subscribers and patrons. This information is the earliest and most reliable that can be obtained. We do not depend upon any one source of supply, but exercise our judgment in selecting the best news from no less than four different directions. This department will doubtless increase in value, and we would suggest that one of the best means of accomplishing this end is an extended co-operative effort on the part of our friends to get to us at the earliest possible moment any item of news which properly belongs under "Advance Information." The forms containing these pages are the last to go to press, and important news sent to us before Monday noon will be published in the issue for the current week.

A correspondent of a leading English newspaper asks "What has become of Edison's phonograph?" The writer proceeds to say that this is "one of the most mysterious disappearances of modern times. A few years ago it was announced that the famous American inventor had perfected this instrument, and some public experiments that were given certainly seemed to support this view. A simple little apparatus, costing probably not more than a sovereign to make, was made to reproduce indefinitely any sound, even to a grand instrumental performance, that had taken place in another hemisphere. Where is a phonograph to be bought?" With phonographs singing popular songs, with banjo, piano, or orchestral accompaniment; playing Wagner and Gilmore selections by orchestras and brass bands, and discussing politics in every corner store in this country; and with many hundreds of phonographs each doing the work of half-a-dozen stenographers in offices all over the country, one simply stands aghast at the mediæval state of British civilization, for, remarks the *Sun*, if the people were ready for the Wizard's wonders the supply would surely be there.

THE ELECTRIC RAILWAY AND FARM PRODUCTS.

It seems feasible and probable that electric railways can be utilized in bringing suburban farm products for immediate use from the place of growing direct to city market houses and provision dealers. The multitude of farm wagons and horses usually found in market districts would then be done away with and business would be facilitated. It is proposed in the grape region east of Cleveland to use old passenger coaches, taking the seats out and making shelves, to transport the crop by electric cars. Mr. Dodge, of that city, a member of the general assembly, has become so deeply interested in this method of transportation, says a local report in the *Leader*, that he will introduce a bill in the legislature authorizing counties and townships to bond themselves to build such roads. He believes that this will solve the problem of better country roads. He calculates that the tracks can be laid for $5,000 per mile, and that a tax of seven and a half cents per acre will pay both principal and interest on such debts. The agrarian interests are rapidly learning the utility of electric railways. Legislative enactment aided by public sentiment should open this new and promising field for the trolley system.

LETTERS FROM A LABORATORY.—VIII.

BY JULIAN A. MOSES.

If you have pieces of brass that are in such a condition that it would be best if they were blackened, they may be coated by a process which, when used by different workmen, is variably successful. Many of the European instrument makers pride themselves on the quality of the black surfaces that they obtain on brass. Its "deadness" and durability are of primary importance and it has been a matter of great difficulty to procure a solution that will work well with all qualities of brass. As a result of long experience, let me say that the following has proved itself most satisfactory: Silver, a 10 cent piece; copper, eight cents. Dissolve each separately, by the aid of heat in nitric acid, being careful not to have too great an excess of acid. Mix both solutions in a china bowl or wide-mouthed bottle and keep covered when not in use. Heat the brass object, previously well cleaned from grease and oxide, to almost a visible red heat, and, holding it by a brass or copper wire, twisted around the most convenient place, plunge it into the solution, taking care that all parts are covered by the now bubbling liquid. Allow it to remain submerged for about 30 seconds. Drain off the superfluous liquid and heat in the Bunsen burner until the entire mass looks like charred wood and no green spots are visible.

Do not heat after this, as the coating is liable to peel off if heated too much. Set it aside to cool and, when quite cold, brush off the extra black powder with a tooth brush wet with lard oil.

There is, however, a green stain on the surface of brass instruments that have remained long out of use which is not easy of removal by the common polish powders. When there is no danger of spoiling a "fit," the following preparation may be used, rubbing in one direction with a cotton rag smeared with it: Rotten stone, 8 parts; oxalic acid, 2 parts; sweet oil, 3 parts; turpentine, enough to make a paste.

When there are surfaces that have become foul with thick grease and oil, and it is not advisable to put them into the usual cleaning solution for removing grease, viz., ammonia or sulphuric acid, it would be best to brush the object with bisulphide of carbon *away from a light*, and rub off the grease while the liquid is evaporating, which it does very quickly.

Where the hard rubber bases of your instruments become spotted, clean with a stick of fine willow charcoal, wet with water, rubbing in one direction if a grain is desired. If you wish a polished surface, rub with a circular motion and afterwards polish with very fine rotten stone and oil, finishing with fine flour.

This subject of a polish is one which has caused quite a difference between the German and American instrument makers. There is no doubt but that for certain fine and finished hand-made instruments, we Americans must bow to the English, French and Germans. The American is too fond of the glitter and glamor of a buff polish, which is hurtful to the eyes of German workmen. These latter insist that the Americans are too superficial; they do not care about the lasting quality of their work. While the Americans, in speaking of their work, agree with Lady Macbeth that: "If 'twere done when 'tis done, then 'twere well 'twere done quickly." It is true, however, that the work on which Lady Macbeth was engaged at the time of the above remark required finish and despatch. But in these days of rush and hurry we cannot wait to have an instrument hand polished when a buff is nearby, but we can afford to, and should, wait to have the joints and fittings of our instruments made as perfectly as possible. This is the only way in which satisfactory and lasting work may be obtained. What a sad commentary on the workman of to-day was the remark recently made by a dealer in second-hand furniture.

While passing a store above the door of which hung the sign "New and Second-Hand Furniture and Instruments Bought and Sold," I noticed a remarkably well-made and solid mahogany desk. Being in need of just such a one, I entered and inquired the price. The desk was perfect in all respects.

I remarked that it seemed, from the style of the desk, that it was made quite a number of years ago, and was remarkably well preserved.

"Yes," replied the dealer, in a sad tone of voice. "That desk was made when there was honest work done; it can't be duplicated now for ten times the price, and I doubt even if it can be duplicated."

This remark was no doubt prompted by his experience, for in a second hand store the quality of an object is easily determined.

So it is with the instruments of to-day. True, we do not know how they will last, while we do know how those made by our fathers have lasted.

Our critics are to come. Let us hope that they will treat us gently.

CORRESPONDENCE.

OUR CHICAGO LETTER.

W. H. McKinlock, of the Central Electric Company, left this week for a two weeks' pleasure trip at the sea shore.

Mr. A. F. Espersen, the supply dealer of Tacoma, Wis., is spending a few days in Chicago this week with friends.

W. C. McKinlock, of the Enterprise Electric Company, is in St. Louis this week making arrangements to open up a branch house at that point.

The **Railway Equipment Company** report a good business during the past week. Among the many orders received were two from abroad calling for supplies.

The **Illinois Central Railroad** will use 125 miles of Simplex rubber wire in connection with the block signal system now being put in by the Hall Signal Company.

The **Many Friends** of W. H. McKinlock will be pained to learn of the death of his daughter, Wilhelmina H. McKinlock, which occurred Thursday of this week.

The **Central Electric Company** report business still increasing. Among the orders received this week were orders for 250,000 feet of conduit, also 165,000 feet of Okonite wire.

R. J. Randolph has severed his connection with the Duplex Electric Company, of Corry, Pa., and has accepted a position as manager of the lighting department with the Central Thomson-Houston Electric Company, Cincinnati, O.

A train on the Calumet Electric Railroad broke in two at Ninety-fourth street and Stony Island avenue on Monday last, which caused the trailer to be thrown into a ditch, whereby 11 passengers were injured, although none seriously.

The **Western Electric Company** are out this week with a very artistic and complete catalogue describing their arc lighting apparatus. The catalogue is nicely gotten up and will be appreciated by the trade, as it enters into all the details and describes fully the merits of their apparatus and the manner of operating.

Messrs. Archer & Rusling have accepted the general Western agency for the Duplex Electric Company, Corry, Pa., with offices at 1325 Monadnock building, where they will be pleased to see their friends. Mr. Archer was formerly constructing expert with the Thomson-Houston Company in this city and has had much experience in the electrical line.

Thomas & Kellogg is the firm name of a new electrical engineering and manufacturing company, with offices at 1006 Pontiac building, this city. Mr. Thomas is well known to the electrical fraternity, having been for some time past connected with the Detroit Electrical Works. Mr. Kellogg has had much experience in the electrical field, and work left in their charge will be completed most satisfactorily.

The **New York Electric Launch and Navigation Company,** General C. H. Barney, general manager, was awarded the contract Wednesday this week by the executive committee, for furnishing and operating a fleet of electric boats which will carry passengers on the inland waters of Jackson Park. The company will be required to build 40 electric launches. They will run through the canals and lagoons inside the park and will have 12 landings in the course of a round trip. Under the arrangements made the Exposition company will get 33⅓ per cent. of the gross receipts.

On **Account of** the increase of Southern and Southwestern trade, the Enterprise Electric Company have opened a branch house at 15 North Ninth street, St. Louis, Mo., in order to execute more promptly orders from this trade which will certainly be appreciated by their customers. The house will be in charge of W. H. Ferris, until recently with the Southern Electric Supply Company, St. Louis, who is well known to the trade, having had several years' experience in the electrical field, where he has made many friends. This company also report a big demand for N. I. R. wire, for which they are general Western agents, having filled many large orders lately, which purchasers claim is giving the very best satisfaction. M. J. B.

Chicago, August 13.

OUR BOSTON LETTER.

The Storage Battery Street Railway Company, of this city, will have a final hearing before the Cambridge, Mass., Aldermen on September 6.

The Worcester and Millbury, Mass., Electric Railway is rapidly nearing completion, and the company expects to have its cars in operation by the first week in September.

The Hubinger and Pool Company, of New Haven, Conn., promises to have its new dynamo and motor ready to illustrate and describe in the REVIEW before September 1.

The Springfield, Mass., Street Railway Company's branch electric road to Indian Orchard and Ludlow was completed two weeks ago, and cars are running successfully.

The Holyoke, Mass., Street Railway Company has equipped all its cars with electric motors, and the change from horses to electric propulsion has proven very satisfactory to the people of Holyoke as well as to the company.

To Increase Capital.—The stockholders of the Eddy Electric Manufacturing Company, of Windsor, Conn., met at Hartford, Conn., August 8, and voted to increase the capital stock from $100,000 to $250,000, and the number of shares from 4,000 to 9,000.

New Officers Elected.—The stockholders of the Cohasset, Mass., Electric Company have elected the following officers: President, A. A. Lawrence; secretary and treasurer, E. F. Ripley; directors, A. A. Lawrence, S. Pierce, J. C. Howe, L. D. Willcutt, C. A. Welch.

Mr. E. H. Brown, of Salem, Mass., is reported as having secured a number of prominent capitalists of this city and Salem as subscribers to his (the "Brown") system of electrical propulsion. The stockholders will hold a meeting in this city next week for the purpose of organizing.

The Carpenter Enamel Rheostat Company, of Bridgeport, Conn., has secured a lease on a large and commodious building in the Northern suburbs of that city, and has already commenced the manufacture of its meritorious product. The company is sending out a neat illustrated catalogue.

Electrical Tanning.—The Boston Daily *Advertiser* of August 12, under the above heading, contains the following:

"Reports from the experiments recently made here with the electrical tanning process do not indicate that they have been entirely satisfactory. Whether the results will be accepted as conclusive and the system condemned remains to be seen. There are electric tanneries abroad, and, according to report, they work very satisfactorily. The process is neither complicated nor mysterious. The hides to be tanned are put into revolving barrels or drums. Into the drums the proper liquid is poured. As soon as the drum has received its load it is closed up hermetically, set rolling and the current is turned on. The current is conveyed into the drum by means of metal rings around the periphery, in contact with similar rings inside the drum and brushes outside. Oxhide is thus tanned in 96 hours (calfskins in 72 and light skins in about 48), as compared with more than one year in an ordinary vat and six months by plain agitation. There is no generation of bad odor, the noise is light, and, most material of all, the tanning is good."

Boston, August 13. W. I. B.

The Balloon in War.

A series of interesting experiments was conducted the other night at Stanford Bridge Grounds, London, with balloon and apparatus invented and improved by Mr. Eric Bruce for use in military signaling at night over intervening woods and hills, says the London *News*. Within the balloon are hung on a small swinging ladder six incandescent lamps, connected by insulated cable with a battery on the ground, worked that night at 24 volts and giving 60 candle-power of illumination. By ready manipulation of the buttons at the instrument the operator flashes on the translucent sides of the balloon the signals of the Morse or any code, and these can be easily read at a distance of six miles.

The balloon used was a small one of 18 feet diameter, containing 1,000 feet of gas, and was held by cable at a height of about 300 feet. The strong wind prevailing rendered the position of the balloon unsteady and uncertain, but the signals were, nevertheless, read by military experts and were answered from a station on land. The experiments were witnessed by Prince Edward of Saxe-Weimar, by military attachés of the Chinese and other embassies, and a number of scientific men. The experiments were varied by hanging the lamps outside below the neck of the balloon and flashing direct. The illuminated balloon, when a few feet above ground, gives a beautiful light and can be utilized when required for executing work at night.

The August number of the *Review of Reviews* contains a character sketch of Mr. Grover Cleveland, written by a gentleman whose qualifications are admittedly the very best. Mr. George F. Parker, who has recently edited Mr. Cleveland's speeches, official messages and other utterances, gives a sympathetic and eulogistic, but careful and candid, sketch of the distinguished standard-bearer of the Democratic party. The sketch follows the well-received article on President Harrison, written for the July *Review of Reviews* by Gen. Thomas J. Morgan.

OUR LONDON LETTER.

The postmaster-general has, at last, practically succeeded in getting the telephone into his hands. He has long seen how it interfered with and supplanted the telegraph, and so diminished the government revenue. In London the telephone is comparatively little used; but in such centers of business as Manchester, Liverpool, Glasgow, Greenock, Bradford, Sheffield, Leeds and Haddersfield, it has superseded the telegraph to a very appreciable extent. The National Telephone Company, having gradually swallowed up all its competitors, has hitherto enjoyed a monopoly of the profits, holding from 90 to 95 per cent. of the telephone business of the country. This state of things, however, is now coming to an end. The government, instead of taking over the telephone by enactment, as was proposed, have commissioned the postmaster-general to deal with the matter in a quieter, but not less effectual, way. On the 16th ult., a bill was passed enabling the Treasury to raise £1,000,000 sterling for the purchase of the trunk lines of the various telephone companies. It is intended to erect main lines of wire between London and Glasgow, Edinburgh and Belfast. The heaviest copper wire would be used in order to secure efficiency, and there would be "spurs" thrown out to all the principal towns.

The London county council at their last meeting resolved to supply electric light to the carriage way on the Thames Embankment, and after some consultation they decided to have an independent installation, which, by an arrangement with the bridges committee and the parks committee, might also light Westminster and Waterloo bridges and the Embankment Gardens. A convenient site for the generating plant would be found on the land belonging to the council under the Charing Cross railway bridge. Ten thousand pounds has been voted for the cost of construction, and it is considered that the yearly expenses will not exceed £2,000.

Messrs. Willing, of 125 Strand, have devised, and the Lithanode and General Electric Company, of 64 Millbank street, Westminster, have adopted from them, a mode of applying electricity to illuminating the interiors of our omnibuses. The company, who have taken out a patent, claim to possess an improved form of lithanode, an active material eminently suited for storage batteries or accumulators. The apparatus consists of a stout wooden box fitting under the driver's seat, and containing a small five-cell battery which works for a period of 15 to 20 hours. When a battery is exhausted it may be removed and a newly charged one dropped in. The recharging can be effected in five or six hours. The lamp is an Edison-Swan five candle-power, and is a very decided improvement on the dull, grimy lamps of oil or compressed gas.

A scheme for a railway in Berlin, closely following the design of the City and South London Line, is described with much detail in the Verein für Eisenbahnkunde. It is projected by the Allgemeine Elektricitäts Gesellschaft. The proposed length of the line is about 30 miles, and the estimated cost £2,550,000, or £68,500 per mile.

In Paris the use of electricity is steadily progressing, though seriously obstructed by the heavy charges imposed by the municipality. It is in the hands of four substantial and energetic companies: The Compagnie Continentale Edison, The Société Parisienne d'Eclairage et de Force par l'Electricité, M. Popp, and the Société d'Éclairage Electrique du Secteur de la Place Clichy. These have already laid in Paris about 110 miles of underground electric mains, and the gross income of the companies will probably amount to six million francs, or £240,000.

But the most interesting continental event of the week has been the inauguration of the Electric Supply Station at Tivoli. The current is generated by six Ganz alternators, driven by Pelton water-wheels, which are set in motion by the falls of that world-renowned valley; and it is conveyed to Rome, over a distance of 22 miles, by four copper wires supported by 712 steel standards. The machinery was started on Monday evening, in the presence of the Minister of Public Works, the Minister of Posts and Telegraphs, and a large number of scientific men of various nationalities; and letters of congratulation were read from several English electricians, who were unable to attend.

I extract the following from the *Journal of Horticulture*. It may, perhaps, prove interesting to some of your readers: "The influence of electric light on the color and production of flowers has been shown to be extraordinary. Tulips exposed to the light have deeper and richer tints, flowering more freely and developing longer stems and bigger leaves. Fuchsias bloom earlier under like conditions. Betunias bloom earlier also and more profusely, growing taller and more slender. In fact, there is every reason for believing that the electric light will be used very profitably in the future as an adjunct to forcing establishments for flowers and garden vegetables."

JOSEPH FFRENCH.

London, August 6.

Authoritative Credit and Dates for Principal Electrical Inventions and Engineering Methods.

TO THE EDITOR OF ELECTRICAL REVIEW:

It seems to me desirable that whatever publication may be made by the United States Census Office, pertaining to electrical invention and development, shall, whenever practicable, give official recognition to those justly entitled to the honor of having been the first to invent, or to bring into practical commercial use, the various electrical inventions and engineering methods that are marked features of the present condition of electrical science and art. This is due to those entitled to the credit, as the judgment of their contemporaries. It is due to our successors, who are entitled to correct records made for the present date. It is due to the enterprise and skill of the American people, who need no greater praise than proper historical statements of their achievements in peace or in war.

That it may be demonstrated whether or not this idea can be practically carried out at the present time, I desire to invite, through your journal, persons having knowledge of the subjects to advise me, giving full name and date, who first invented or used commercially in America, continuous current, constant voltage and variable ampereage, dynamos, lamps and motors; continuous current, variable voltage and constant ampereage, dynamos, lamps and motors; alternating current, constant voltage and variable ampereage, dynamos, lamps and motors; and alternating current, variable voltage and constant ampereage, dynamos, lamps and motors; also trolley contacts, single or double.

In addition to this information, similar credit and dates for the following engineering methods would be of great present interest and of increasing value; following which should be a description of the first isolated and central station plants and electric railroad.

By whom and when first commercial use was made in United States of:	Name.	Date.
Incandescent Lamps—		
Operated by continuous currents		
Operated by alternating currents		
Wired in multiple		
Wired in series		
Wired to converters		
Wired to accumulators		
Wired on arc lamp circuits		
Wired on power circuits		
Arc Lamps, single carbon—		
Operated by continuous currents		
Operated by alternating currents		
Wired in multiple		
Wired in series		
Wired to converters		
Wired to accumulators		
Wired on incandescent lamp circuits		
Wired on power circuits		
Arc Lamps, double carbon—		
Operated by continuous currents		
Operated by alternating currents		
Wired in multiple		
Wired in series		
Wired to converters		
Wired to accumulators		
Wired on incandescent lamp circuits		
Wired on power circuits		
Stationary Motors—		
Operated by continuous currents		
Operated by alternating currents		
Wired in multiple		
Wired in series		
Wired to converters		
Wired to accumulators		
Wired on incandescent lamp circuits		
Wired on power circuits		
Electric Locomotives—		
Operated by continuous currents		
Operated by alternating currents		
Wired in multiple		
Wired in series		
Wired to converters		
Wired to accumulators		
Wired on incandescent lamp circuits		
Wired on arc lamp circuits		
Wired on power circuits		
Converters—		
Used for incandescent lighting		
Used for arc lighting		
Used for stationary power		
Used for locomotive power		
Accumulators—		
Used for incandescent lighting		
Used for arc lighting		
Used for stationary power		
Used for locomotive power		

I shall be glad to receive suggestions pertaining to this subject from those who have given it thought or are interested in it.

Respectfully,

ALLEN R. FOOTE,

Special Agent Eleventh Census.

A MODERN POWER STATION.

DETAILED DESCRIPTION OF THE ELECTRIC STREET RAILWAY SYSTEM OF LITTLE ROCK, ARKANSAS, ILLUSTRATED FROM THE CONSTRUCTING ENGINEER'S DRAWINGS.—NOVEL FEATURES OF A GREAT POWER GENERATING PLANT.—A SUMMER THEATRE FORMS A PART OF THE PLANT.

It was in the early '70's that a street railway was first talked of in the city of Little Rock, Arkansas. At that time the city had a population of less than 10,000 people. The talk amounted to nothing beyond the expressed desire of enterprising citizens to push their city to the front, and nothing was done toward the practical realization of this desire until several years later, when the city had about 12,000 inhabitants.

In the latter part of 1876, John Cross and Charles R. Diver, business men of Little Rock, associated with them Mr. L. D. Cain, of Hot Springs, Ark. On January 10, 1877, the city council of Little Rock passed an ordinance authorizing these gentlemen to build a street railway in that city, occupying the most important streets. They, however, built only about two miles of track, operating with small cars which served the people for some years.

It was not until July 1, 1884, that the city government closed a contract with the Little Rock Street Railway Company, granting this company the right to build a cross town line, as the rapid growth of the city, which at this time had reached about 25,000 population, demanded a better service. Prominently identified with the new company were a number of leading and most enterprising business men of Little Rock. The railways were operated separately, but were at last secured and operated under the same management.

Three years later, as the city grew, there came other demands for a more efficient service in order to open up the suburbs, resulting in the granting of a franchise to the City Electric Street Railway Company, the stock of which was owned largely by Philadelphia capitalists.

This ordinance was passed December 6, 1887, and granted the company the right of way over valuable and important thoroughfares and a perpetual franchise. They immediately began operations and built about four miles of track over the western and southwestern parts of the city to a point about a mile and a half beyond the city limits. They did not, however, adopt electric power, but propelled their cars with steam dummy engines.

On April 1, 1890, Mr. H. G. Allis, president of the First National Bank of Little Rock, Arkansas, to whom Little Rock is indebted for its electric street railway service, purchased a controlling interest in the Citizens' and Little Rock Street Railway Companies, and organized the Capital Street Railway Company.

On July 22, 1890, this company secured authority from the city council to propel their cars by electricity, and a short time later Mr. Allis secured control of the City Electric Street Railway Company and the other lines were then leased to this company. The authority of the city government to lease these roads was passed on the 16th of February, 1891, and on the same date the Capital Street Railway Company was granted additional rights.

In October, 1891, the company closed a contract with the Thomson-Houston Electric Company to equip the system with electricity. The local company built its own power house, track and road-bed. Mr. H. P. Bradford, general manager of the company, personally superintended the construction of the road-bed and track. The Thomson-Houston Company's contract work, consisting of the overhead construction and the installation of the electrical machinery, was placed in charge or Mr. E. E. Downs, one of the constructing engineers of that company.

The engineering of the power station was placed in charge of Mr. B. J. Arnold, consulting engineer of the Chicago office of the Thomson-Houston Electric Company, who designed the plant and superintended its construction. Mr. Arnold was assisted by Messrs. Rickon & Thompson, architects, of Little Rock, Arkansas, to whom should be given the credit of the artistic front and details of the upper stories of the building. A number of sites for a power station were examined, but the one upon which the station stands was selected by the engineer on account of the exceptional natural advantages, the merits of which will be referred to further on. While the plans of the power station were being prepared the work of excavating for the foundations was done and the material delivered for the construction of the track. The track laying began on the 3d and the construction of the power house on July 15, 1891. The work was pushed rapidly by the heads of the respective departments and on November 22, 1891, the trial trip was made in a blinding snow-storm without accident or delay of any kind. On the following morning the road was formally and permanently opened for traffic, and has operated successfully up to the present date without an accident or delay of any kind attributable to the imperfect construction of the power station or the electrical work.

During this period of 131 days that elapsed from the beginning of the construction to the opening of the road, 32 days were lost on account of Sundays and rainy weather, leaving but 99 actual working days. During this time the entire system of about 20 miles of road was either taken up and new rails and ties laid, or the track narrowed from broad to standard gauge, involving the use of about 1,400 poles, 41 miles of No. 0 bare copper wire for trolley and return circuits, and 40,000 feet No. 000 insulated wire for feeders. At the power station there were 1,000 cubic yards of solid slate excavated, over 1,000,000 brick laid, 333,000 feet of lumber erected on the structure and 1,000 horse-power of engines, boilers and condensing machinery put in place during this period. After the road had started, the front of the car barn and offices were completed as rapidly as possible.

EXECUTIVE MANAGEMENT.

To Mr. H. G. Allis, who owns the controlling interest, is due the credit of financiering the enterprise and getting the road to a practical completion.

ECONOMY.

The road is now operating 20 thirty horse-power motor cars and six trailers, and is doing it upon 12 tons of slack coal, costing $1.70 per ton per day of 24 hours' run, or less than one-half ton of slack coal per car per day. The cars operate for 18 hours per day, but the small electric light engine, running 18 arc lights for lighting the car barns and Summer theatre, is run all night, and this fuel consumption is included in the above amount. There has been no scientific test made to ascertain the economy of the plant, but these figures were taken from the coal bills themselves, showing the actual amount of coal purchased and consumed throughout a period of some months, so that practically they are of more value than a scientific test would be, as they show the actual consumption of the plant.

These records were taken before the steam piping had been covered or the live steam purifiers put in operation, so they do not show as great an economy as the plant is capable of giving. From records made during the short time the above improvements have been in operation, it is not unfair to believe that the plant is now driving the load on less than 10 tons of slack coal per day, but it is not thought best to claim this economy until a longer period of time has elapsed, in order to verify the present figures.

To those who are interested in the practical construction of electric railways, it may be interesting to have a more detailed description of the construction of this road.

TRACK.

There are about 20 miles of track laid, mostly of the 35 pound steel "T" rail, while through the business portion of the city it is built of 52 pound Johnson girder rail, placed on chairs. The ties are spaced 2½ feet apart, center to center, and are mostly sawed oak. There are 35 single and one double track curves, six turn-outs and one cross-over in the system. The track is bounded throughout with No. 6 bond wire, joined to the rails with Wheeler channel pins. These bond wires are attached to a No. 0 copper ground wire running the entire length of the track and returning to the power station. These ground wires are attached to old car wheels and other metal plates which are sunk in the old wells and ravines at suitable intervals along the road so as to secure as perfect a ground as possible. The return wires are also attached to the water works pipes of the city wherever it is convenient. There are also heavy copper wires running from the switchboard in the dynamo-room to the Arkansas River, in the rear of the power house, where the terminals are attached to old car wheels sunk in the river. It will thus be noticed that the rail return circuit of the entire system is as thoroughly grounded as it was practicable to make it.

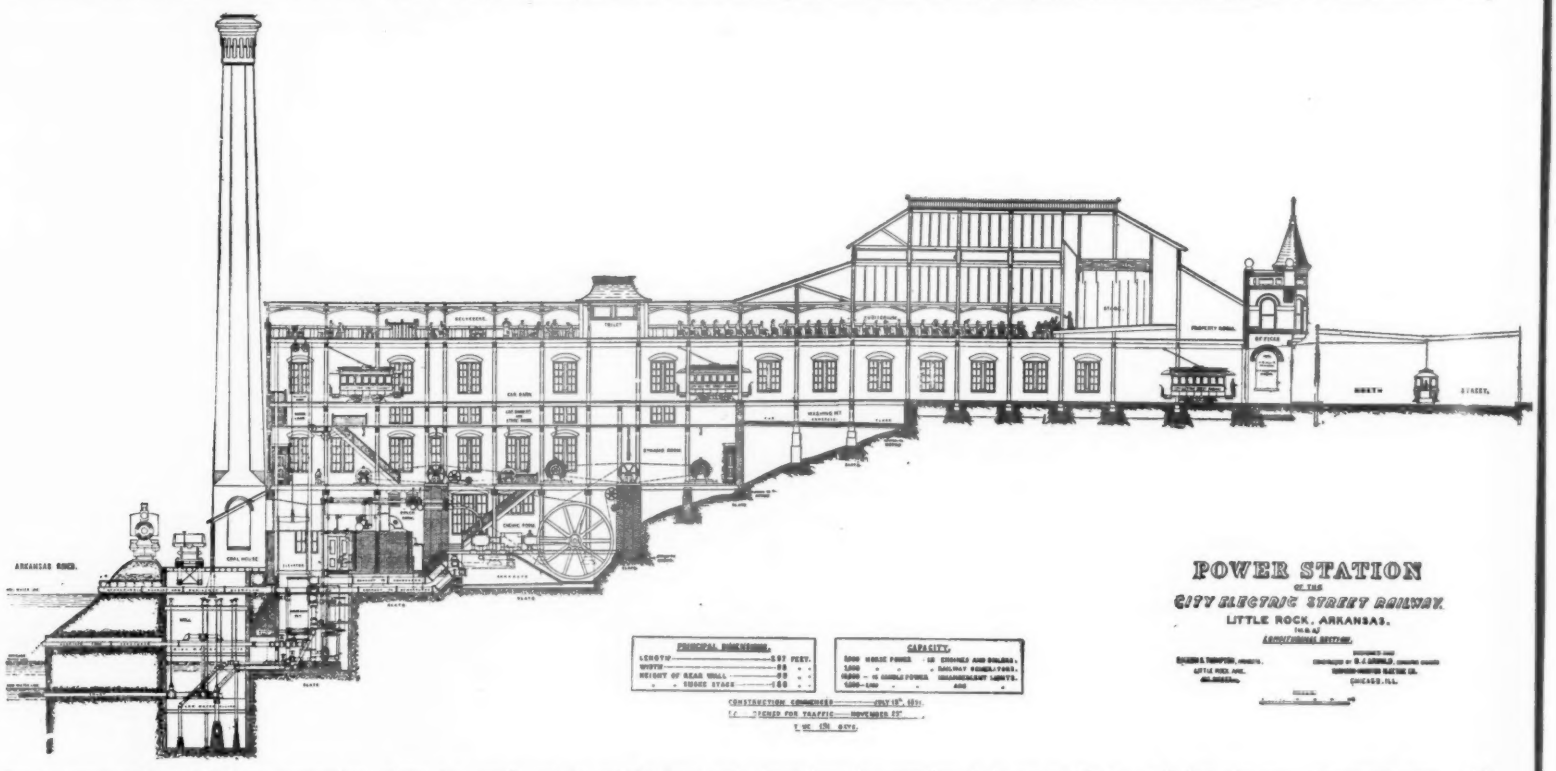
OVERHEAD CONSTRUCTION.

About 20 miles of No. 0 hard drawn copper wire was used for the trolley system of the road in addition to about 40,000 feet of No. 000 insulated wire for feeders. The trollies and feeder systems are supported upon about 1,400 poles, 100 of which are Milliken latticed iron, which are used through the business portion of the city. Special insulators are used on the arms of the iron poles to prevent leakage, and where there is excessive strain on them caused by curves or turn-outs. The cross suspension method of overhead construction is used throughout and the poles set with a small amount of rake so that when drawn up with the steel span wires they stand perfectly straight and in almost absolute line. The thoroughness of the electrical work will be appreciated when it is known that the first time the current was sent out over the line not a ground was discovered or any defect in the electrical construction noticed.

POWER HOUSE SITE.

The present location of the power house was selected for its natural advantages, some of which are as follows:

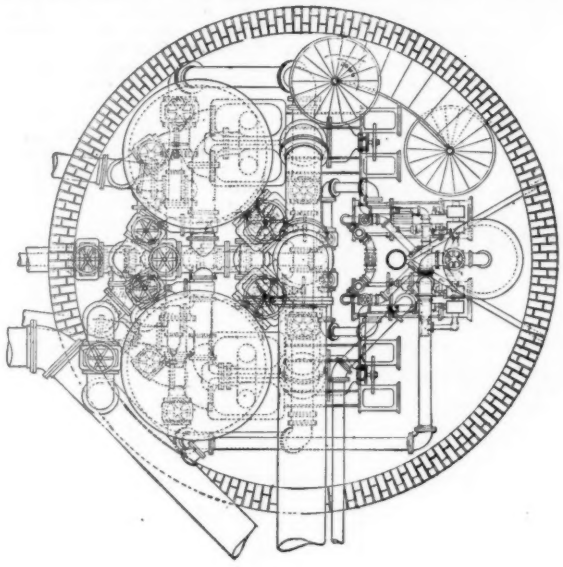
It is located on the Arkansas River, on the site where the water works plant formerly stood which supplied the city with water for a number of years. The wells formerly used by this company had been abandoned owing to the inability of the water company to filter the water sufficiently well for city use. The wells, upon which had been spent about $15,000, were thus practically completed, and the water question partially solved. The property that went with these wells consisted of a lot 100 feet wide by 350 feet deep, extending south to North street, over which the principal line of the road, extending from the depot to the city, runs. This would bring most of the cars by the power station every trip, if this site was selected. Again there was a solid slate sub-structure which would give a good foundation, and the profile of the lot was such that it enabled a building to be designed which brought the entire power station, car barn, repair shops, offices, etc., under one roof and on one set of foundations, making it thereby cheaper to construct than it would have been had two pieces of real estate been purchased and two distinct buildings constructed. The main line of the St. Louis, Iron Mountain & Southern Railway runs along the river bank in the rear of the building, enabling a side-track to be built cheaply and fuel delivered directly into the coal house with but one handling. Again, being located upon the river at a point midway between Little Rock and Big Rock, overlooking the river for miles in either direction, and the Ozark Mountains on the north and west, it gives the most beautiful view that can be obtained in the city, which resulted in the designer providing for a Summer theatre to be placed upon the roof. To those not familiar with the location of this plant, the idea of a theatre on the top of the power station may seem absurd, but when it is remembered that the roof of this building has an area of over six-tenths of an acre, and is located about 100 feet above the river, entirely removed from the noise of the machinery, and giving one of the most beautiful views that can be obtained in the Ozark



Mountains, the idea may not seem so peculiar. Again, as the power station is located on the main line of the street railway, the theatre produces a source of revenue to the road that makes it quite an important factor.

ARRANGEMENT OF THE PLANT.

Beginning on the main line of the railroad running along the river bank, we first come to the large well, 30 feet in diameter and 60 feet deep, into which the water from the river is let for filtering. It will be noticed that the rise of the water in this river is 33 feet from high to low water, and that certain seasons of the year the water contains over 30 per cent. of solid matter, consisting mostly of sand and vegetable substances, consequently, the means for handling it must be somewhat complicated. Before starting upon the plans for this plant, the designer secured the government records of the river extending back to 1844, thereby ascertaining the extreme high and low water marks. A 14 inch pipe, which the water company had used, was found in place running from the river into the outside well. This pipe is laid two feet below low water line, so that the water supply in the well is always insured. Below this pipe, it will be noticed on the sectional drawing, Fig. 1, there is a low water filter composed of a wooden frame-work supporting layers of charcoal, coke and pressed hay, through which the water filters by gravity into the lower portion of the well. From the bottom of this well, where the filtered water remains, lead the suction pipes to the condenser pumps and other pumping machinery used in the plant. These pumps are placed on brick foundations in the condenser pit located in the boiler room, as shown on the plan, Fig. 2. This pit is 20 feet in diameter and 30 feet deep, and in it will be placed 3,000 horse-power of condensers and pumping machinery, arranged for either jet or surface condenser from the same system of pumps, the details of which will be referred to later; 1,000 horse-power is now in.



PLAN OF CONDENSER PIT.

SCALE IN FEET.

COAL HOUSE.

On a level with the main track of the railroad, formerly mentioned, is the side-track shown in the longitudinal section, Fig. 1. This track is carried across the outside well on trusses. Next to the side-track comes the coal house, which is 20 feet wide and extends the entire length of the building, and is capable of storing 300 tons of coal. That portion of the coal house which extends over the outside well is carried on iron "I" beams and concrete construction.

BOILER ROOM.

The boiler room, as shown on the plan, Fig. 3, is a room 44x89 and 25 feet high. In it will be placed, when the plant is completed, eight 250 horse-power water tube boilers, three of which are at present installed. Over the top of these boilers is a sheet-iron breeching extending to the space between the center row of columns, where they join the main trunk breeching leading to the smokestack located outside the main building. The plant is at present operated from an iron stack five feet six inches in diameter and 180 feet high, set off to one side so that the permanent brick stack can be constructed in its proper position without interrupting the operation of the plant.

The permanent stack will be built of brick and will be 84 inches in diameter by 180 feet high.

ENGINE ROOM.

Just south of the boiler room is the engine room with its floor located six feet higher than that of the boiler room, thereby providing for the exhaust piping system to be located under the floor. This room is 49x89 feet and will contain, when completed, 3,000 horse-power of engines; three of these, aggregating 1,000 horse-power, are at present installed.

DYNAMO ROOM.

Passing upward from the engine room on stairs located on either side of the engine room, we enter the dynamo room (Fig. 4), 133 feet long by 88 feet six inches wide. In this room will be located two distinct line shafts resting upon the tops of the partition walls of the building. From the north line shaft, which is at present installed, there will be belted eight 110 horse Thomson-Houston railway generators, five of which are now in use. There will also be an additional 110 horse railway generator belted direct from a high speed engine, located below the engine room, for the operation of the "owl trains" after the main railroad part of the plant is shut down. The other line shaft is located on the top of the wall at the south end of the engine room, and from it will be driven the lighting machinery. The two shafts will be cross connected at their centers with a 54 inch belt, thereby enabling any generator in the house to be driven from any engine in case of accident to any one of the engines. The railroad switchboard is located in the north end of the building, as shown on plan of dynamo room (Fig. 4), and the lighting switchboard in the south end, so that the leads from the dynamo to switchboard may be as short as possible, also keeping the railway and lighting plants distinctly separate. Over each row of generators and the line shafting extends an overhead single track railroad with the necessary differential pulleys, etc., for lifting out of an armature or box caps. This railway runs to the elevator shaft so that the heavy part may be delivered directly into the elevator and transferred to the machine shop above with but little labor.

PIT ROOM.

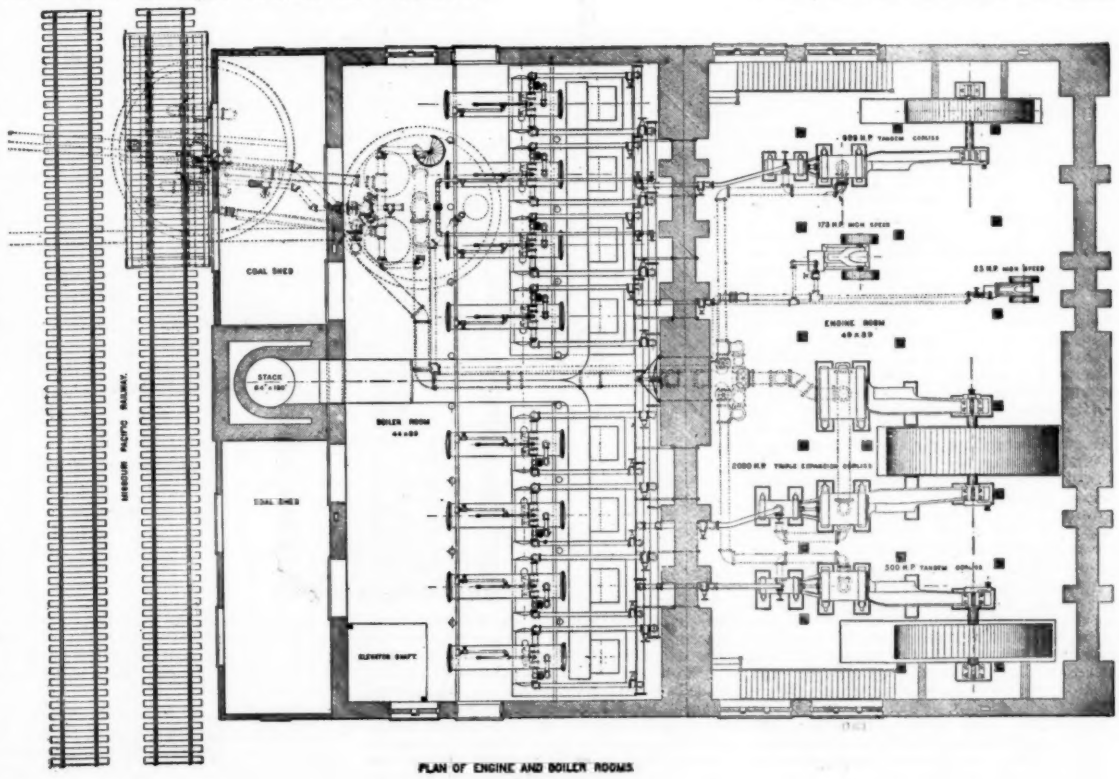
On each side of the dynamo room are stairways extending up to the pit room above. This room was placed in the plant to provide for easy access to the motors and cars for making repairs at all times, without necessitating the changing of location of the cars. In the rear of this room, on the river end, is a machine shop 15 feet wide and 88 feet long, a portion of which is partitioned off for a supply room. The heavy portions of the car machinery can be dropped down into this pit room, placed on hand trucks and drawn to the machine shop for repairs with but very little physical exertion on the part of the mechanics. It also provides an easy means for wiping the cars.

WASHING PIT.

Extending 50 feet south of this pit room is the washing pit having a tar concrete floor, sloping to the south so the drainage will run into the sewer connected at that end, thereby preventing the water from flowing over the dynamo room. This washing pit extends the entire width of the building under all of the tracks so the cars from either track can be run over the pit, washed, drained and run back to place without any transferring.

CAR BARN.

On each side of the pit room extend stairs rising into the car barn. This room is 38 feet six inches wide by 297 feet long and contains eight tracks, 4 feet one-half inch gauge, and is capable of storing 96 motor cars. In the rear on the river side are located the small benches and stands for taking care of the head-lights and other small repairs of the cars, giving a pleasant airy room for the car barn employés. The floor of this room has a slight fall from the rear of the building to the front, so that in case of fire the cars can be gotten out of the house rapidly. These eight tracks swing into the main line of the road with curves, thereby doing away with the transfer table which, by some, is considered objectionable, and in case of fire would hinder greatly in getting the cars out.



PLAN OF ENGINE AND BOILER ROOMS.

SCALE IN FEET

SUMMER THEATRE.

On top of the car barn roof is located the summer theatre and pleasure garden, before mentioned, capable of seating an audience of 1,000 people in the auditorium proper, and about 400 around the tables and places of amusement in the Belvidere. The entrance to the theatre is from the front of the building, up one flight of stairs, having a total rise of but 16 feet. Suitable fire escapes are designed to be placed on each side of the building when the theatre is completed. It will be noticed that the audience is but one short story above ground, so the question of safety is well provided for. In the rear of the stage are provided dressing rooms for the actors, while the offices of the railroad company are located immediately over the front of the power house and one story above the ground, while the conductors' and motor men's room is on the ground floor under the offices.

FOUNDATIONS.

As before stated, this station stands upon a formation of solid black slate, which is as hard as ordinary lime-stone. The formation of the slate, however, is on an angle of about 45°, so that in order to secure a foundation for the North wall of the building, the one on the river side, it was necessary to excavate about 20 feet below the level of the railroad track to reach the solid slate. This excavation required about two weeks of time before the brick laying could be commenced. Inasmuch as the slate was fractured in different places, it was not thought best to trust it to hold the foundation bolts for the engines, consequently, holes were excavated in this slate, and the foundations of the engines built of concrete and capped with several courses of brick, upon which the stone foundation caps for the engines are set. These foundations have proven so satisfactory that no vibration whatever can be detected in them when the engines are doing the heaviest work. The first story of the building, from the foundation up to the level of the dynamo room floor, is laid in Louisville cement and sand, while from the dynamo room floor to the top of the building the walls are laid in lime mortar.

DRAINAGE.

It will be noticed by examining the longitudinal section (Fig. 1) that a drain pipe extends from behind each cross wall to the sewer, to take care of the surface water that necessarily would accumulate behind these walls were no outlet given it. At all other places in the plant where water can accumulate suitable drain pipes are provided.

ELEVATOR.

An elevator large enough to take a complete motor truck is to be located in the northwest corner of the building and runs from the boiler room to the car barn floor. By this means a cinder car can be lowered to the car barn tracks and out onto the line, where the cinders are distributed for surfacing the tracks. It also allows car trucks, supplies and heavy freight to be unloaded directly from the railroad onto the elevator and raised to the floor on which it is to be used.

ELECTRICAL EQUIPMENT.

The present electrical equipment consists of 28 Thomson-Houston double 15 horse motor cars and five 110 horse multipolar railway generators, with the necessary switchboard and overhead construction appliances, with provisions made for the adding of four more generators and other cars without any additional expense, except for the purchasing of the machinery. The plant is designed for the addition of an electric lighting plant having a capacity of 10,000 sixteen candle-

power incandescent lamps, and 1,000 two thousand candle-power arcs, a portion of which will be added as soon as the necessary business arrangements can be made.

ENGINES.

The present equipment of engines consists of Hamilton Corliss tandem compound condensing engines having cylinders 20x36x48 and 16x30x48, respectively. Also one 8x10 Ideal high speed engine for driving 18 arc lights now in operation in the building. The engine room is designed for an additional 2,000 horse-power triple expansion Corliss engine, which will drive the lighting plant when installed, and one 175 horse high speed engine for driving the railway generators to operate the "owl trains," or those trains that run at night after the main plant is shut down.

BOILERS.

There are now three 250 Heine boilers installed and provision made in the boiler room for the addition of five similar boilers when the plant is extended, the connection for the steam piping being in and ready for same.

CONDENSERS.

There is at present one 1,000 horse-power Smith-Vaile duplex condenser installed and two Gordon steam pumps for the boiler feeders, each one of which is capable of supplying the entire plant. Provision is made for an additional 2,000 horse-power condenser.

SHAFTING.

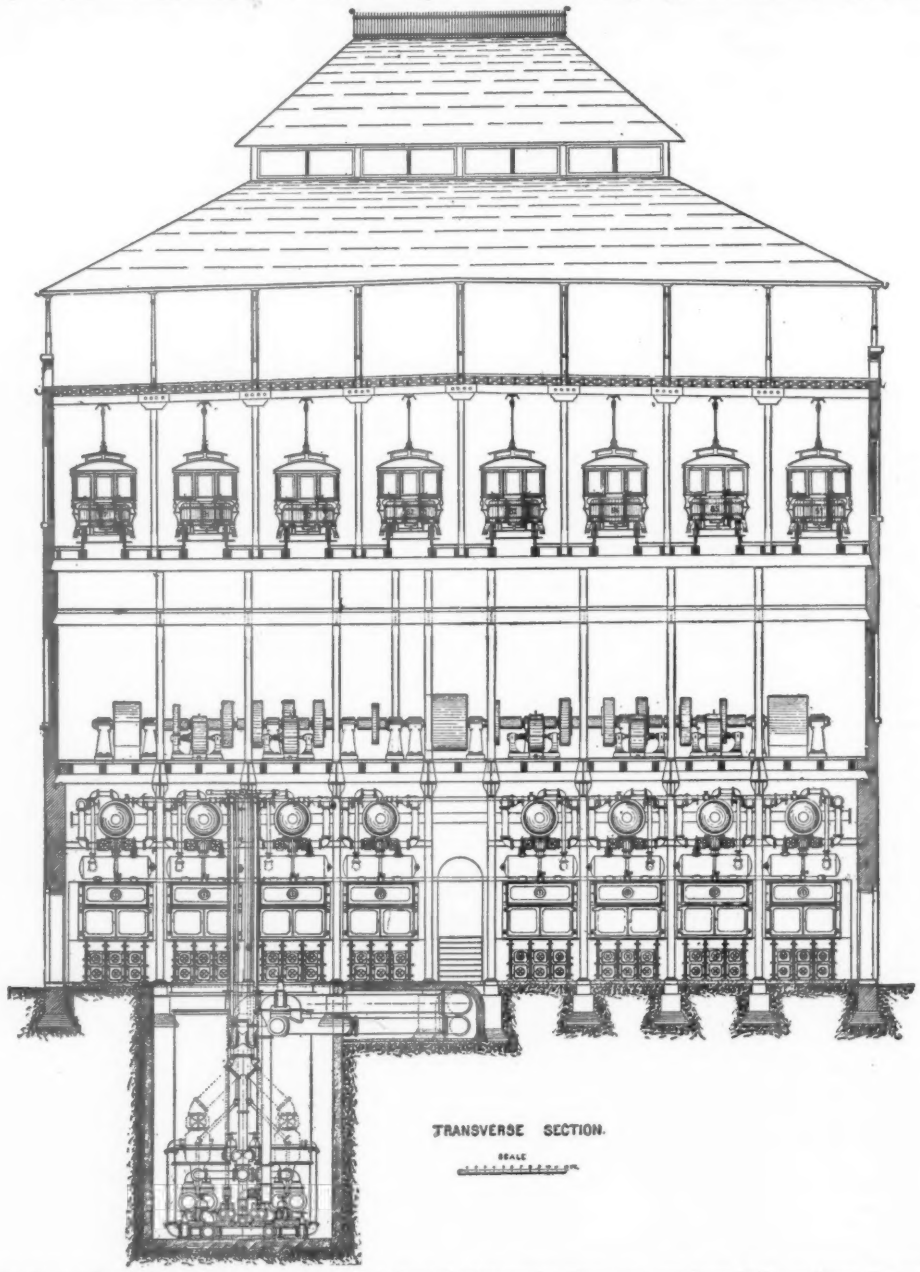
The shafting now running consists of about 80 feet of 6½ inch hammered iron shafting with five 62x15 inch friction clutch pulleys, with the necessary plain pulleys, tighteners and clutches to receive the power from the two large engines now installed. The shaft is divided near the center so that one portion of it can be kept going in case of a hot journal on either part. The cap stones are set and the belt holes made in the foundations, ready to receive the other line shaft for driving the electric lighting machinery when the time comes for placing it.

BELTING.

There are at present two main belts in the plant, one of which is 54 inches wide and 135 feet long, the other is 36 inches wide and 125 feet long. These belts transmit the power from the engines to the line shaft. There are five 14 inch belts which transmit the power from the line shafting to the railway generators.

PIPING SYSTEM.

The piping of this plant is arranged in duplicate throughout, so that it is unnecessary to shut the plant down on account of the breaking of the piping. There are two water connections from the river to the outside well, two suction pipes from the outer well to the boiler feed pumps. There are also two risers from the boiler feed pumps to the main headers, which extend across the boiler room, for supplying feed water to the boilers. These risers are arranged with suitable valves and cross connections so that either pump will deliver water up either riser through either header to the boilers, either through the live steam purifiers or directly in the boilers as the engineer desires. The suction pipes to the pumps are arranged so that the water can be taken from the hot wells of either of the surface or the jet condensers, the outside well or direct from the river. The condenser pumps are so piped that the plant can be run either jet or surface condensing, or both at the same time. The overflow pipe from the condenser is placed about four feet above the average water line in the river, and the air pumps low enough to permit the condensing water to flow into the air pumps when the river is at its normal stage, thereby saving the energy that would be required to lift the condensing water were the air pumps placed higher. The auxiliary overflow pipe is placed two feet above the extreme high water line and the piping so arranged that, when the water rises to the above overflow pipe, the water from the condenser can be delivered through the auxiliary pipe. This pipe has already proved its usefulness, as the plant was operated successfully through the recent Southern floods, which brought the water to the highest point since the extraordinary floods of 1844. The plant operated successfully through the entire time without being bothered in the least. Over each boiler is placed a live steam purifier and the piping arranged so that the boiler feed pumps deliver feed water through these purifiers into the boilers or directly into the boilers, as desired. Arrangements are made whereby the steam and water valves for the condensing system and boiler feed pumps are all handled by wheels placed on a level of the boiler room floor, making it unnecessary for the engineer to go down into the condenser pit, except for making repairs or the changing over from one system of condensing to the other. An iron spiral stairway extends to the bottom of the pit, and the top of the pit is left opened for ventilation, except in front of the boilers, where it is covered to allow firing space for the boilers immediately in front of it. The exhaust steam from the engines is led through pipes under the engine room floor and through a 24 inch pipe located in a tunnel under the boiler room to the condensers in the pit, while an auxiliary 20 inch pipe is led through the same tunnel out through the building to the river, into which all drain pipes and auxiliary exhausts are led so, that there is no blowing of steam or waste in the plant visible. This pipe is used only for exhaust steam in case of accident to the condensers, and automatic relief valves are placed between each engine and this pipe, which will open in case of accident to the condenser, thereby permitting the exhaust steam to go directly to the atmosphere without the attention of the engineer. On top of the dome of each boiler is placed a tee, out of which leads the main steam pipe from each boiler to the main header which extends entirely across the boiler room; from the other side of this tee extends an auxiliary pipe running to the auxiliary header which also extends the entire width of the boiler room. It will be noticed that each boiler is piped independently to both the main and auxiliary steam headers and suitable valves are placed for supplying either header as the case demands. The steam pipes to each engine joined to both headers and valves are placed so that the steam can be taken from either pipe. Chapman bronze seated valves are used throughout the entire plant wherever high pressure steam or water comes in contact with them and lighter valves are used on the exhaust connections. The exhaust steam from the steam cylinders of the condensers and boiler feed pumps is passed through a small tubular heater, thence to the auxiliary exhaust pipe. The boiler feed pumps deliver the feed water through this heater, thereby absorbing whatever heat there is in this exhaust which would ordinarily be wasted. Arrangements are provided so the exhaust from the condensers and boiler feed pumps can be turned into the condensers, thereby getting the benefit of the vacuum in case the heater is not in use. By opening and closing certain valves, the water can be shut out of the outside well, thereby permitting the filters to be cleaned. While this is being done the pumps draw their supply directly from the river.



TRANSVERSE SECTION.

SCALE

FIRE SERVICE SYSTEM.

From the boiler feed pumps runs a vertical riser through all of the stories to the top of the building, off from which on each floor runs a system of horizontal pipes with hydrants located at suitable places. These hydrants are provided with hose and reels and are always in readiness in case of fire. There is an electric bell system placed in the plant whereby the engineer can be signaled by any one in any portion of the building in case a fire breaks out. The pressure from the boiler feed pumps is always on the fire service pipes and an automatic arrangement provided whereby the boiler feed pumps can be turned into fire service pumps almost immediately. It will be remembered that each one of these pumps is amply large to supply the plant, so that one pump is always in reserve for fire service. The water car for wetting the track of the road, and also the water for sanitary service in the building, are supplied from the fire service pipes, so there is no water consumed in the building from the city, although the system of piping is connected to the city mains as an extra precaution.

ENGINE ROOM GAUGE BOARD.

Located in the engine room, in plain view of the engineer and immediately behind the boilers, is a polished oak gauge board, upon which is mounted an auxiliary steam gauge, glass water gauge and gauge cocks for each boiler, besides the necessary vacuum gauges, clocks, recording steam gauges, etc., enabling the engineer on duty to keep a constant check upon his firemen who handle the water and steam.

CONTRACTORS.

The work was executed by the following contractors:

BUILDING.

Brick work, Noah Hamlet, Little Rock, Ark.; wood work, W. D. Holtzman, Little Rock, Ark.; iron work, D. R. Wing & Company and E. C. Wehrfritz, Little Rock, Ark.

MACHINERY.

Electrical equipment, Thomson-Houston Electric Company; engines, Hoovens, Owens & Rentschler Company, Hamilton, O.; boilers, Heine Safety Boiler Company, St. Louis, Mo.; shafting, Hill Clutch Works, Cleveland, O.; belting, Chicago Belting Company, Chicago; condensers, Smith-Vaile Company, Dayton, O.; boiler feed pumps, Gordon Steam Pump Company, Dayton, O.; heaters, Wm. Baragwanath & Company, Chicago; live steam purifiers, Hoppes Manufacturing Company, Springfield, O.; steam piping, Nick Peay & Co., Little Rock, Ark., and Crane Company, Chicago; steam pipe covering, Chicago Fire-proof Covering Company, Chicago; smokestack, D. R. Wing & Company, Little Rock, Ark.

DISTINGUISHING CHARACTERISTICS.

In closing, it might not be amiss to call attention to some of the peculiar features of this plant, inasmuch as it is a radical departure from anything of its kind that has yet been built, so far as the writer knows.

First. The general idea of the building extending up a hill-side, with the respective stories over-lapping each other, was suggested to the designer by the natural formation of the land, as the level of the electric railway which the plant was to operate was about 50 feet above the level of the steam railroad track from which it was to secure its supply of coal.

Second. The utilization of a short story for a pit room under all of the cars, thereby allowing cleaning and repairs to be made without switching.

Third. Providing for a washing pit under each track in the house.

Fourth. Placing the line shafting on top of the partition walls, thereby making the walls serve a double purpose.

Sixth. The location of the car barn on the top of the power house.

Seventh. The placing of a summer theatre on top of the structure, thereby securing the entire plant under one roof.

Eighth. The inclining of the tracks of the car barn toward the front of the building for convenience in case of fire.

OUR SEATTLE LETTER.

Seattle now has 130 more telephones than Tacoma.

The **Oakesdale** telephone exchange has been burnt out.

The **Point Defiance Railway** at Tacoma is now using electricity.

The **Machinery** for the Grant Street electric road is being set up at the power house.

The **Conductors and Motormen** on the Union Trunk Line have organized a brass band.

A **Resolution** for the reduction of water and electric light rates has been introduced into the Tacoma city council.

A **New 240 Horse-power** electric generator has been ordered by the Union Trunk Line, of Seattle, to be used in case of a breakdown.

The **Sidney Council** has granted an electric light franchise for a plant to be run by the power from a sash and door factory in the town.

Morris McCarty succeeds A. E. Roe as general superintendent of the Fairhaven and New Whatcom Electric Street Railway Company.

The **Union Electric Company,** of Seattle, has received two 133 horse-power generators which are to be used in supplying power for elevators and stationary motors.

Whitman County had a lively electric storm on June 30. The telephone switchboards at Clay, Johnson, Lewiston, Colton, Uniontown and Pullman were burned out.

The **American District Telegraph Company,** of Seattle, has lowered its rate to five cents for 12 blocks or less. There is quite a lively rivalry between this company and the Home Messenger Company.

The **Track for** the new electric railway at Olympia, the first to be constructed in that city, is now laid for over three miles, and everything is ready for operation, except the cars, which have been delayed in coming from the East.

The **Canadian Pacific Railway** has decided to build an electric tramway from Vancouver, in British Columbia, to Lulu Island, a distance of 12 miles, through the richest farming land in the province. Tenders for the work have been called for.

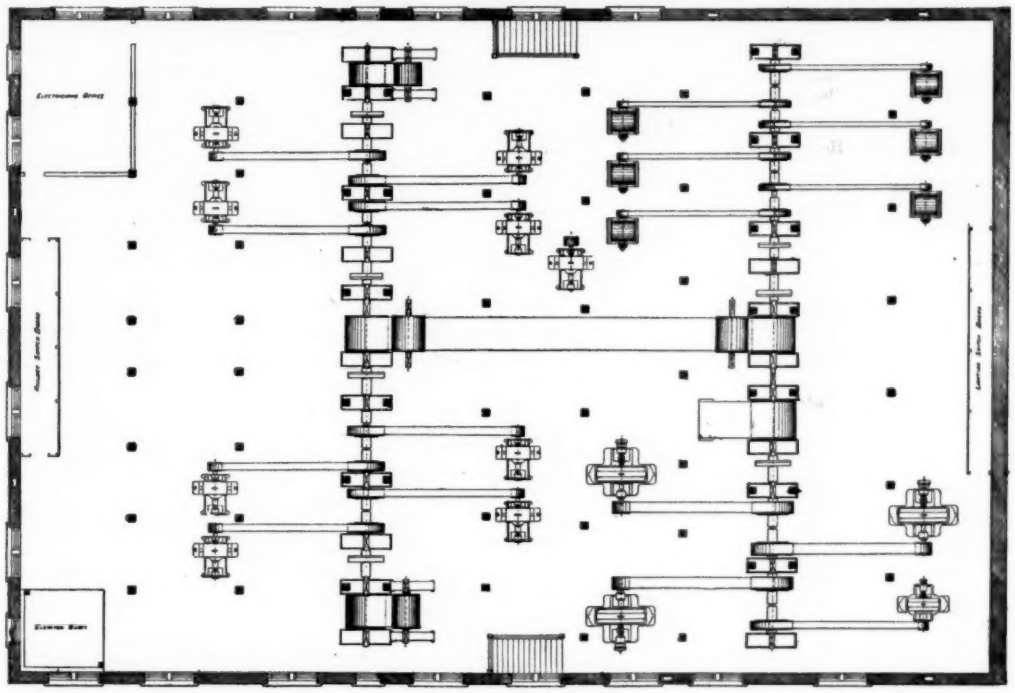
The **New Line** of the Sunset Telephone Company has been opened 42 miles to Snohomish. B. H. Vollans has charge of the Snohomish exchange. The line has also been extended to Everett but no exchange will be opened there for the present.

The **Consolidated Street Railway Company** is negotiating with G. C. Phinney for the improvement of Woodland Park on an extensive scale. The company proposes to take charge of the park and make Summer gardens in it and use it as a pleasure resort.

The **Seattle Street Car Men's Association** has chosen the following officers: President, J. H. Rosald; vice-president, George Holcomb; recording secretary, John Lilley; financial secretary, J. P. Hawks; chaplain, George Ellsworth; treasurer, Fred. Reed, and master of ceremonies, C. I. Grant.

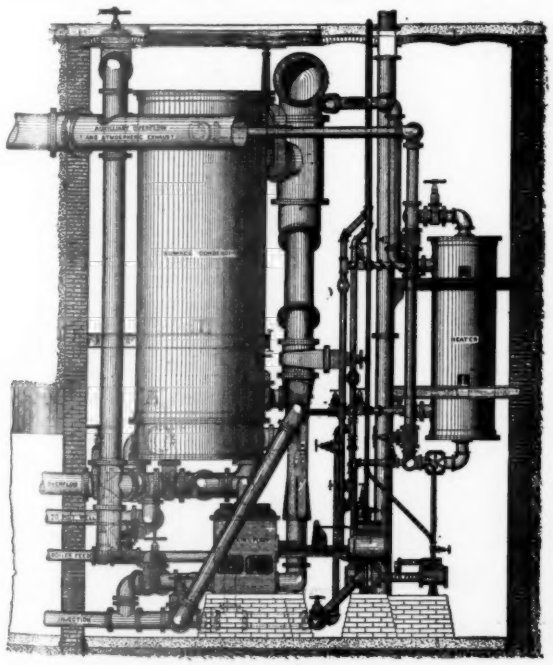
The **Consolidation** of the branch offices of the Thomson-Houston and Edison Electric Companies in this city under the control of the General Electric Company took effect on June 25. The headquarters for the Sound country are at this city in charge of W. J. Grambs. Portland will be the headquarters for Oregon, Southern and Eastern Washington, with a branch office at Spokane.

L. H. Griffith who has begun his work as manager of the electric roads of Tacoma, has planned several improvements. He will re-equip the road with ten new cars, partly closed and partly open, light and of high speed, with the latest improved single reduction motors. They will be built in Tacoma and every effort will be made to have them running by the time the exposition opens. A twin engine of 900 horse-power, similar to the one now running, will be put in position at once.

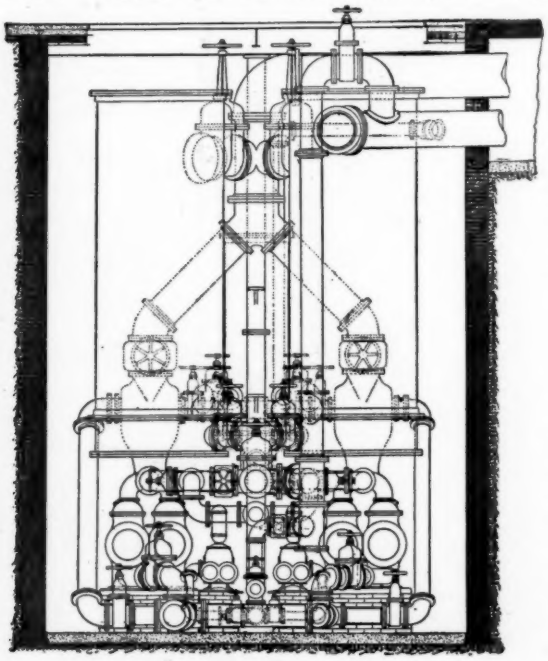


PLAN OF DYNAMO ROOM.

The Electric Railway of the Ranier Power and Railway Company will soon be ready to operate. On the main line the poles are all erected and the cross-wires strung. The rails, which weigh 40 pounds to the yard, are put out all along the route. The street for the two miles in the north end has not yet been opened, but the grade for the road is prepared for the ties. The company has also applied for another mile of franchise in the north end of the city. Six cars are on the way to Seattle for the line. The power house, now in course of erection, will have motors giving 700 horse-power. The length of the line is seven miles.



LONGITUDINAL SECTION OF CONDENSER PIT.



TRANSVERSE SECTION OF CONDENSER PIT.

Chief Engineer Knox, of the Tacoma Railway and Motor Company, had a singular and painful experience a few nights ago. He was working in the recess back of the large switchboard in the power-house, when he came in contact with the person of his assistant, who was standing in such a position as to complete the circuit through Mr. Knox's hand, which was firmly clasping a copper rod carrying a 500 volt current. Mr. Knox was thrown violently against the opposite wall, and the flesh was burned and torn away from his hand, causing a painful wound. When the conductor was examined, it was found that the lump of flesh and sinew that had been torn off the hand was exactly duplicated in copper, forming an odd looking excrescence on the metal rod. The engineer has had that portion of the rod removed, and will preserve it as a curio.

George P. Low, of San Francisco, the electrician of the Pacific Insurance Union, a union of the insurance companies doing business on the coast, was in Seattle a few days ago. He spent some time examining the electric light plants and the wiring in the principal mills and buildings. To the correspondent of the ELECTRICAL REVIEW he said that his particular mission was to determine the fire hazard from the arrangement of the wires and other apparatus. "As a matter of fact," he continued, "of the four artificial modes of lighting—oil lamps, gas, candles and electricity — electricity causes the fewest fires. A compilation of causes of fire in this country during the last six years shows that oil lamps are responsible for nine per cent. of the fires started; gas is responsible for 3.8 per cent. of them; candles for 1.9 per cent. and electricity for .57 per cent., or about half of one per cent. So you see that electricity is by far the safest kind of light. Accordingly, we want to do all we can to encourage its use; and my skill and experience are freely at the service of any man who wishes to consult me in any matter touching the fire hazard from electricity. I find that the chief trouble arises from the fierce competition between electricians. They will cut prices on each other and will then try to recoup themselves by putting in poor material or doing the work in a hasty, slovenly manner. The average man can tell whether a mason is building him a fair wall, but in examining electrical work he is wholly at sea. An electrician of even moderate skill can fool him completely, and pass off as first-class very inferior work. We wish to bring about here such a state of things as now exists in San Francisco. There the architects in drawing the specifications incorporate for the electrical work the standard specifications adopted by the underwriters. The architects or building superintendents must see that these specifications are carried out completely, and then the danger of fire from electricity will be reduced to the lowest point. Your city charter provides that the electrical work in buildings shall be under the supervision of the plumbing inspector. How much he knows of the subject I am not aware, for I have not even talked with him yet. But if he has not some expert knowledge, there should be a deputy, an expert, whose special duty it should be to inspect electrical work. There is enough of it in this city to keep a man busy. You are much ahead of San Francisco. Indeed, I believe that these cities of the Northwest have as many and as extensive electrical plants as can be found in all of California. San Francisco has about 15,000 incandescent lights, and Seattle alone probably has as many. In electric street car service you are far ahead. Your dynamos, too, are larger. The largest in San Francisco is of 80 horse-power, while yours run up to 220 and 240 horse-power."

Seattle, Wash., August 8. H. L.

His Body a Storage Battery.

Senator Hansbrough, of North Dakota, according to his own statement, ought to be the most magnetic man in Congress or out of it. Here is what he told a reporter as to his sensitiveness to electricity in the air:

"About 6 o'clock yesterday morning," said the Senator, "I became aware of the fact that the air was highly charged with electricity. It seemed to me that my fingers clutched two invisible poles of a battery, and in spite of every effort, I could not loosen my grasp. As the evening wore on the charging of my system was conducted in a more vigorous fashion, until at length I was in what may be termed electrical paroxysms. My muscles were contracted just as they would be under the influence of a most powerful battery, and my best efforts to counteract the feeling were of no avail. These strange sensations were at times extremely painful, the center of disturbance being in the region of the spleen. Once or twice after the storm broke there was temporary relief, but it was not until the thunder had died away in the distance that I found myself free from the power of the current. Then I was as weak as I would have been had I contended for three or four hours with half a dozen professional wrestlers."

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

Electric Railways.

WASHINGTON, D. C.—On July 29 the President signed the Act of Congress incorporating the Washington and Great Falls Electric Railway. The road is to run parallel to the Conduit road along the north bank of the Potomac River, a distance of 16 miles. The trolley system is authorized. The road is to be built and equipped in the best manner. The Conduit road is the great driving boulevard of the District of Columbia, along which is situated the palisades of the Potomac, the Glen Echo Chautauqua, Woman's National Home, Cabin John Bridge, the largest single stone span in the world, and the Great Falls of the Potomac. The road will have double tracks, and the Washington terminal will have elevated tracks a distance of 3,000 feet. Stock and bonds of the road to be determined by the Judge of the Supreme Court of the District of Columbia, not to exceed $1,000,000, and are to be limited to the actual cost of the road and its equipment. Charter is perpetual. Stock books will be opened August 23, at the office of the Washington and Chesapeake Beach Railway Company, Washington Loan and Trust Company building, Washington, D. C., and company organized for business immediately thereafter.

BOSTON, MASS.—New York capitalists have formed a syndicate to buy up all the street railway companies in Essex county and consolidate them under the name of the North Shore Traction Company. Jesse Seligman and Perry Belmont are said to be at the head of the syndicate, and the deal has progressed so far that there is little probability of its failure. The company will control the Naumkeag Street Railway, of Salem, and the Lynn and Boston and the Belt line roads, of Lynn. The plan is to make the North Shore Traction Company a blanket company to lease the three roads for 99 years and to guarantee the bonds.

RENO, NEV.—The Reno Electric Railway and Land Company; capital, $200,000. The company proposes to build and operate electric railroads and street railways, and to purchase land in Nevada and California. The incorporators are F. G. Newlands, William Thompson, C. T. Bender, T. K. Stewart and M. D. Foley.

HASTINGS, NEB.—It is expected that work on the new electric line will be commenced this Autumn.

READING, O.—At a recent meeting of the Reading council a petition was presented from citizens asking the appointment of a committee to confer with the directors of the Mt. Auburn electric road, and to receive propositions from them looking to the extension of the road to Reading. Mayor Griener appointed Councilmen William Ebeling and John Koehl, and Citizens Michael Meiser, John M. Topmuller and A. G. Ankenbauer, who will act in conjunction with a similar committee from Lockland.

LEAVENWORTH, KAN.—The Leavenworth Electric Transit Company; capital, $500,000. The first directors are: C. F. Brotherton and Newman Erb, of Kansas City, Kan.; S. F. Neeley, C. S. Harlough and William C. Hook, of Leavenworth. The purposes for which the corporation is formed are the construction and acquisition, by purchase, lease or otherwise, of lines of street railway, to be operated by electric power. The main line of the proposed road is intended to run from Fort Lawrence through the city of Leavenworth to the National Soldiers' Home and Kansas State Penitentiary. The estimated length of the road is 15 miles.

NEW YORK, N. Y.—The company formerly known as the Metropolitan Traction Company, of New Jersey, has been incorporated as the Metropolitan Traction Company, of New York. The capital is $10,000,000. It has power to construct and equip railroads, acquire leases of real and personal property, and to exchange its stocks, bonds, and other evidences of indebtedness for the like of any other corporation. The directors of the company are: Francis Lynde Stetson, Albert W. Fletcher, Francis Sedgwick Bangs, Leslie Ryan and Howard Van Sinderen, all of this city, and Daniel H. Hasbrouck and Charles E. Warren, of Brooklyn.

NEWARK, N. J.—The Newark Plank Road Company is an applicant to the State Subway Commission for leave to erect poles and string wires in this city.

HYDE PARK, MASS.—The Suburban Street Railway Company has been granted franchises to build an electric line through Hyde Park and Dedham.

COLUMBUS, O.—Harper and Short, of this city, have secured a franchise to build an electric line along the county road to Gambier.

COUNCIL BLUFFS, IA.—J. W. Paul, of the Union Land and Improvement Company, is an applicant for a franchise to build an electric line through the Northwestern part of the city.

WELLSTON, OHIO.—Harry Wells is at the head of a company organizing for the purpose of building an electric railway from Hamden to Coalton and Wellston, a distance of 10 miles.

EASTON, PA.—The Easton and South Easton Railway Company; capital, $100,000. Organized to build a cable and electric railway 10 miles in length. President, Henry A. Sage; directors, Winfield S. Hulick, Frederick K. Green, H. W. Cooley and Frank R. Sage.

PHILADELPHIA, PA.—It is understood that the Philadelphia Traction Company will urge the passage of an ordinance permitting it to use the trolley system on the Ridge avenue line.

PHŒNIXVILLE, PA.—A company is being formed here, called the Phœnixville Electric Lighting, Power and Street Railway Company, the object being to light the town by electricity and to lay and furnish motive power for an electric street railway.

Electric Lighting.

HOLLISTON, MASS.—The selectmen have granted the Holliston Electric Light Company an extension of their franchise for one year.

WEBSTER CITY, IA.—The plan to establish an electric light company at this place seems to have failed.

EARLVILLE, N. Y.—The Earlville "Low Down" Wagon Company has been granted a franchise to erect poles and string wires through the village for the purpose of electric lighting.

OSAGE, IA.—Osage has voted to give the city council power to grant a permit to the Osage Electric Light Company for a term of years.

ST. CLAIR, MICH.—C. J. Hoyt, of Warsaw, Ind., is figuring with the city fathers for the placing of the new electric lighting plant for which $15,000 has been voted.

PORTLAND, ORE.—Negotiations are pending for a big deal between the Willamette Falls Electric Company and the General Electric Company, looking to the development of the extensive property of the Willamette Falls Electric Company in Portland and Oregon City.

PORTLAND, ORE.—Portland Gas Company; capital, $1,000,000. Promoters, A. L. Mills, C. H. Lewis, Henry Farling, C. A. Dolph, all of Portland, Ore. Incorporation papers sent to Dolph, Bellinger, Mallory and Simon, Portland, Ore.

BERWICK, PA.—Berwick Electric Light Company; capital, $25,000. Promoters, Fred. H. Eaton, B. F. Crispin, Jr., S. H. Watts. Incorporation papers sent to C. W. Miller, Bloomsburg, Pa.

BURLINGTON, IOWA.—Burlington Electric Lighting Company; capital, $100,000. Promoters, Frank G. Jones, Josiah Stedman and E. C. Walsh, Burlington, Iowa.

WYANDOTTE, MICH.—The city has decided, by a vote of 530 to 83, to establish a municipal electric light plant. The cost will be about $12,000.

Telephone and Telegraph Companies.

BRISTOL, N. H.—The Bristol Telephone and Telegraph Company; capital, $5,000, has filed articles of incorporation.

MIDDLEBOURNE, W. VA.—A telephone line will be built between this place and Sisterville.

CATLETTSBURG, KY.—Catlettsburg wants telephone connection with Ironton, Ashland, Ceredo and Huntington.

BRISTOL, VT.—The Bristol and Hebron Telephone Company has been organized in Bristol.

Consolidation.

NORTH PLAINFIELD, N. J.—The North Plainfield and Dunellen electric light plants, under the ownership of Drs. Cooley and Davis, have been consolidated and the machinery will be taken from Dunellen to the North Plainfield station. Better light is now to be expected in both places.

ROBB MACKIE,
Consulting Electrical Engineer,
NEAVE BUILDING,
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SUPERINTENDENT WANTED.
For a Central Station in Connecticut. Must be a man thoroughly familiar with Arc, Alternating and Direct Incandescence Systems, as well as with outside and inside work, be thoroughly capable of taking entire charge of a Station and able to furnish unquestioned references to that effect. Address, stating full particulars, salary expected, etc.,
"SECRETARY,"
Care ELECTRICAL REVIEW,
13 Park Row, N. Y.

NOTICE.
Notice is hereby given that the City of Springfield, Mo., will receive sealed proposals up to twelve o'clock, noon, of Tuesday, the 6th day of September, 1892, for furnishing said city and the citizens thereof with electric lights.
Specifications and form of proposal will be furnished on application to the City Clerk.
By order of the Council,
G. W. HACKNEY,
City Clerk.

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Best Bell, pressed metal gong, long phosphor bronze springs and platinum contact points. Most reliable bell in the market. In four sizes, 2½ inches, 3 inches, 3½ inches and 4 inches. Samples sent post-paid to all dealers upon receipt of 50 cents and business card.
THE TIME ELECTRIC CO.,
C. O. BARTLETT, Gen. Manager,
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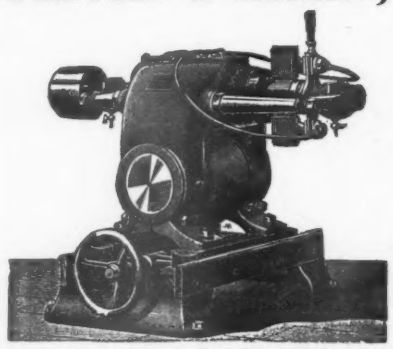
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